

Table of Contents

Table of Contents	
List of Figures	
List of Tables	iii
Acronyms	v
Executive Summary	vi
Chapter 1. Background	
1.1 Purpose of this Plan	2
1.2 Program Vision, Goals, and Guiding Principles	7
1.3 Mid-Columbia Coho Reintroduction Project Documents	10
1.4 Consistency with Council's Requirements	
1.5 Relationship to Other Programs, Projects, and Plans in the Region	17
1.6 Decision Process and Schedule	27
1.7 Master Plan Development Team	28
Chapter 2. Existing Environment	
2.1 Description of the Subbasins	
2.2 Status of Coho (Oncorhynchus kisutch) in the Subbasins	
2.3 Status of Other Anadromous and Resident Fish in the Subbasins	
2.4 Status of Habitat	
Chapter 3. Summary of Feasibility Study Results and Resolution of Critical Uncerta	
3.1 Benefits to Coho	
3.2 Risks to Other Species	72
Chapter 4. Overview of Proposed Program and Alternatives	78
4.1 Introduction	78
4.2 Issues/Alternatives Considered in Program Development	
4.3 Proposed Program	81
4.4 Program Risks	100
4.5 Program Benefits	
Chapter 5. Biological Program Details	
5.1 Broodstock Development Phase 1	
5.2 Broodstock Development Phase 2	
5.3 Natural Production Phases	
5.4 AHA Calculations	
5.5 Habitat Improvement Phase	
Chapter 6. Proposed Facilities	
6.1 Broodstock Capture Facilities	
6.2 Rearing Facilities	
6.3 Acclimation Facilities	
Chapter 7. Monitoring and Evaluation Plan	
7.1 Project Performance Indicators	
7.2 Species Interactions	
7.3 Genetic Adaptability	
Chapter 8. Cost Estimates and Schedules	
8.1 Introduction	
8.2 Schedules	
8.3 Capital Costs	
8.4 Operating Costs	
8.5 Total Program Cost Schedule	
Chapter 9. References	
Appendix A Fish Culture Guidelines	
Appendix B.1 Rearing Facilities Alternatives	
Appendix B.2 Acclimation Facilities Alternatives	
Appendix C.1 Wenatchee Rearing Facilities	
Appendix C.2 Methow Rearing Facilities	
Appendix C.3 Wenatchee Acclimation Facilities	204
PF	

Appendix I Appendix I Appendix I	C.4 Methow Acclimation Facilities	204 204 204
	List of Figures	
Mid-Columb	oia Coho Restoration Site Map	vi
Figure 1-2.	Project Schedule	27
Figure 2-1.	Wenatchee Subbasin in Relation to Upper Columbia River Dams and Subbasins	32
Figure 2-2.	Methow Subbasin in Relation to Upper Columbia River Dams and Subbasins	33
Figure 2-3.	Data and Information Pyramid	53
Figure 2-4.	EDT Model Output for the Assessment Unit Summary for Wenatchee Coho Salmon	55
Figure 2-5.	EDT Strategic Priority Summary for Wenatchee Basin Coho Salmon	56
Figure 2-6.	EDT Model Output for the Assessment Unit Summary for Methow Coho Salmon	57
Figure 2-7.	EDT Strategic Priority Summary for Methow Basin Coho Salmon	58
Figure 3-1.	Coho SARs at McNary Dam	69
Figure 3-2.	Smolt-to-Adult Survival Rates for Hatchery Coho in the Methow and Wenatchee Rivers	69
Figure 3-3. Columbia F	SARs for Reprogrammed LCR Brood and First-generation MCR Brood Reared at Lower acilities	70
Figure 3-4.	Number and Distribution of Coho Redds in Wenatchee Basin, 2000 – 2005	71
Figure 4-1.	Sites of Fish Culture Activities and Existing Facilities	87
Figure 4-2.	Wenatchee Subbasin Proposed Acclimation Sites	89
Figure 4-3.	Methow Subbasin Proposed Acclimation Sites	90
Figure 6-1.	Site of Proposed Dryden Adult Holding and Incubation Facility	132
Figure 6-2.	Typical Constructed Habitat	135
Figure 6-3.	Eightmile Constructed Habitat Location	136
Figure 6-4.	Heath Ranch Constructed Habitat Location	140
Figure 6-5.	Proposed Wenatchee Subbasin Acclimation Sites	144
Figure 6-6.	Proposed Methow Subbasin Acclimation Sites	150

List of Tables

Total MCCRP capital costs	ix
Peak annual operating expenses (2012)	ix
Table 2-1. Wenatchee subbasin coho population characterization	36
Table 2-2. Wenatchee and Methow subbasin habitat conditions	52
Table 2-3. Wenatchee basin coho adult productivity values predicted by EDT	55
Table 2-4. Methow basin coho adult productivity values predicted by EDT	58
Table 2-5. Summary of key actions in the Wenatchee subbasin and estimated time frames for initial and completion	
Table 2-6. Summary of key actions in the Methow subbasin and estimated time frames for initiation completion	
Table 3-1. Broodstock collected and smolts produced	68
Table 3-2. Natural coho production in the Wenatchee river, Brood Years 2000-2004	71
Table 4-1. Wenatchee subbasin program summary	83
Table 4-2. Methow subbasin program summary	84
Table 4-3. Proposed smolt release numbers	85
Table 4-4. Proposed program facilities, existing and new	88
Table 4-5. Coho production timetable	91
Table 4-6. Summary of M&E activities	92
Table 4-7. Program schedule	95
Table 4-8. Total MCCRP capital costs	95
Table 4-9. Peak annual operating expenses (2012)	96
Table 5-1. Proposed release numbers and locations for the Natural Production phases in the Wens subbasin	
Table 5-2. Proposed release numbers and locations for the Natural Production phases in the Methesubbasin	
Table 5-3. Natural production phase goals and expected results (based on AHA calculations) for the Chiwawa River	
Table 5-4. Harvest rates used in projecting the results for Chiwawa River natural production phase	s111
Table 5-5. Natural production phase goals and expected results (based on AHA calculations) for the White River	
Table 5-6. Harvest rates used it projecting the results for White River natural production phases	111
Table 5-7. Natural production phase goals and expected results (based on AHA calculations) for N Creek	
Table 5-8. Harvest rates used in projecting the results for Nason Creek natural production phases a	112
Table 5-9. Natural production phase goals and expected results (based on AHA calculations) for the Little Wenatchee River	
Table 5-10. Harvest rates used in projecting the results for Little Wenatchee River natural production phases	

Table 5-11. Natural production phase goals and expected results (based on AHA calculations) for t mid and upper Methow River	
Table 5-12. Harvest rates used in projecting results for mid-and upper Methow River natural production phases	
Table 5-13. Natural production phase goals and expected results (based on AHA calculations) for t	
Table 5-14. Harvest rates used to project results for Chewuch River natural production phases	114
Table 5-15. Natural production phase goals and expected results (based on AHA calculations for T River	
Table 5-16. Harvest rates used to project results for Twisp River natural production phases	115
Table 5-17. Management schedule for the disposition of adult returns to the Wenatchee subbasin of the Natural Production Implementation Phase	
Table 5-18. Management schedule for the disposition of adult returns to the Wenatchee subbasin of the Natural Production Support Phase (Initial)	
Table 5-19. Management schedule for the disposition of adult returns to the Wenatchee subbasin of the Natural Production Support Phase (Final)	
Table 5-20. Management schedule for the disposition of adult returns to the Methow subbasin during Natural Production Implementation Phase	
Table 5-21. Management schedule for the disposition of adult returns to the Methow subbasin during Natural Production Support Phase (Initial)	
Table 5-22. Management schedule for the disposition of adult returns to the Methow subbasin during Natural Production Support Phase (Final)	
Table 6-1. Wenatchee rearing locations and numbers	130
Table 6-2. Methow rearing locations and numbers	134
Table 6-3. Wenatchee acclimation site general information	145
Table 6-4. Wenatchee acclimation site water and space requirements	146
Table 6-5. Wenatchee acclimation site environmental conditions	147
Table 6-6. Methow acclimation site general information	151
Table 6-7. Methow acclimation site water and space requirements	151
Table 6-8. Methow acclimation site environmental conditions	152
Table 8-1. Planning, design, permit, and construction schedule	177
Table 8-2. Detailed schedule for planning, design and construction	178
Table 8-3. Monitoring and evaluation detailed schedule	179
Table 8-4. Planning, design, and permits cost summary	180
Table 8-5. Planning, design, and permits costs details	181
Table 8-6. Environmental process and permit requirements	182
Table 8-7. Facility construction cost	185
Table 8-8. Capital equipment cost schedule	186
Table 8-9. Rearing cost detail	187
Table 8-10. Operation and maintenance cost detail	188

Table 8-11.	Monitoring and evaluation cost detail	189
Table 8-12.	General and administrative cost detail	189
Table 8-13.	MCCRP total project cost schedule	190

Acronyms

AHA All H's Analyzer (an analytical model)

BPA Bonneville Power Administration

CCPUD Chelan County Public Utility District

DCPUD Douglas County Public Utility District

EDT Ecosystem Diagnosis and Treatment (an analytical model)

ESA Endangered Species Act

ISRP Independent Scientific Review Panel

M&E Monitoring and Evaluation

NEPA National Environmental Policy Act

NMFS/NOAA Fisheries National Marine Fisheries Service/National Oceanic &

Atmospheric Administration

NPDES National Pollutant Discharge Elimination System

NPPC/NPCC Northwest Power Planning Council/Northwest Power and

Conservation Council

NTTOC Non-Target Taxa of Concern (sensitive species)

ODFW Oregon Department of Fish and Wildlife

PUD Public Utility District

TWG Technical Work Group (Mid-Columbia TWG for this project)

UCSRB Upper Columbia Salmon Recovery Board

USFS United States Forest Service

USFWS United States Fish and Wildlife Service

WDFW Washington Department of Fish and Wildlife

YN Yakama Nation

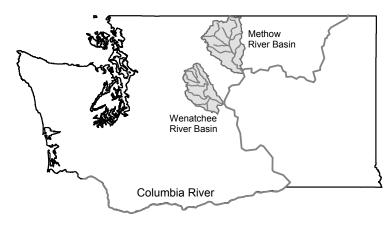
Executive Summary

Indigenous natural coho salmon no longer occupy the mid-Columbia river basins. Columbia River coho salmon populations were decimated in the early 1900s. For several reasons, including the construction and operation of mainstem Columbia River hydropower projects, habitat degradation, release locations, harvest management, and hatchery practices and genetic guidelines, self-sustaining coho populations were not re- established in mid-Columbia basins. Since that time, conditions and practices have changed. Some of the local habitat causes of coho depletion have been corrected, although there is still work to be done.

The Yakama Nation's long-term vision for coho reintroduction is:

To re-establish naturally spawning coho populations in mid-Columbia tributaries to biologically sustainable levels which provide significant harvest in most years.

The figure shows the location of the Mid-Columbia Coho Restoration Program within the State of Washington.



Mid-Columbia Coho Restoration Site Map

Restoration approaches are described in terms of biological objectives and numeric goals. Biological objectives include:

- 1) Develop locally adapted, naturally spawning coho stock in the Wenatchee and Methow river subbasins by 2026.
- 2) Evaluate the efficacy of coho reintroduction in Mid-Columbia tributaries.
- 3) Increase the freshwater productivity of coho salmon in the Wenatchee and Methow subbasins.

Coho reintroduction will be considered successful when the following numerical restoration goals are achieved:

Goal 1 - The 3-year mean escapement of natural origin returns in the Wenatchee (upstream of Tumwater Dam) and the Methow river subbasins exceeds 1,500 per subbasin,

Goal 2 - A total harvest rate of 23%, which includes a 10% mixed stock harvest, 10% mainstem harvest, and 5% terminal harvest in most years.

Studies of the feasibility of reintroducing coho in the Wenatchee and Methow subbasins began in 1996 and demonstrate that the vision of an optimistic future held by Yakama Nation (YN) and Washington Department of Fish and Wildlife (WDFW)is possible. The Yakama Nation along with project participants and the Mid-Columbia Technical Work Group (TWG) developed two goals from which to determine the feasibility of reintroduction coho to mid-Columbia tributaries:

- 1) Determine whether a broodstock can be developed from lower Columbia River coho stocks whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region and
- 2) Initiate natural reproduction in areas of low risk to sensitive species and in other select areas to study the risks and interactions with sensitive species.

Both feasibility studies goals have been achieved. To test whether Feasibility Goal 1 could be met, researchers used as performance indicators coho survival at various stages, the spatial distribution of returning adults, and to a limited degree, reproductive success. To date, two generations of broodstock development have occurred and transfers of lower Columbia River coho have been discontinued. To address Feasibility Goal 2, critical uncertainties regarding species interactions, as planned in the HGMP (2002) were investigated. The issues identified in the HGMP are as follows: 1) Rate of predation by hatchery coho on spring chinook fry, 2) rate of predation by hatchery coho on sockeye fry, 3) amount of superimposition of spring chinook redds by spawning coho, 4) rates of residualism, and 5) amount of competition for space and food during freshwater rearing of naturally produced coho juveniles as measured through microhabitat use and growth evaluations. The evaluations answered most of the critical uncertainties; and the ones that remain are addressed in the M&E program.

The proposed Master Plan builds on the success of the feasibility phase and is designed to achieve coho restoration goals as identified in the Tribal Restoration Plan (*Wy-Kan-Ush-Mi Wa-Kish-Wit*) and in the Wenatchee and Methow subbasin plans. We present a phased approach to restoration which incorporates development of a mid-Columbia hatchery broodstock, local adaptation to tributaries in the Wenatchee and Methow basins, and habitat restoration that will benefit coho as well as ESA-listed spring chinook, steelhead, and bull trout.

The **broodstock development phases** are designed to eliminate transfers of lower Columbia River stocks and then encourage adaptation of the broodstock so that returning coho can reach key habitat within the subbasins.

Once broodstock development goals are met, **natural production phases** will focus on decreasing domestication selection and increasing fitness in the natural environment. In these phases, hatchery coho will be introduced to habitat areas where Ecosystem Diagnosis and Treatment (EDT) analysis predicts coho would be the most successful; and hatchery and natural broodstock compositions will be managed to increase the proportion of natural influence (PNI)

in the population with the goal of having a PNI value > 0.5—that is, the natural environment must have a greater influence on the population than the hatchery environment.

The **habitat improvement phase** is expected to last 15 years, concurrent with the broodstock development and natural production phases. It represents a comprehensive effort to increase the productivity and capacity of coho salmon in the natural environment by coordinating with other entities to help implement the habitat improvement schedule developed for the Upper Columbia Salmon Recovery Board (UCSRB). A 50% cost-share position would identify, solicit funds for, and implement habitat improvement projects.

The M&E program is designed to monitor and evaluate the results of reintroduction so that operations can be adaptively managed to optimize hatchery and natural production while minimizing any negative ecological impacts. Pursuing this goal, research data collection and analysis is structured to: 1) demonstrate when the reintroduction program is meeting the established phased restoration goals; 2) determine whether a change in status of sensitive species is occurring and whether it is a result of coho reintroduction; and 3) provide science-based recommendations for management consideration. The M&E plan is closely coordinated with other monitoring efforts in the Wenatchee and Methow subbasins, resulting in cost sharing and preventing the duplication of efforts.

The Mid-Columbia Restoration Plan continues the reintroduction of coho salmon in the Wenatchee and Methow subbasins through the artificial production and acclimation/release of the progeny of locally captured broodstock. Proposed releases decline from a peak of 2,155,000 smolts in 2012 to no releases at program termination in 2026.

Multiple rearing and acclimation systems have been evaluated during the master plan process. Systems and site locations are proposed that are cost effective, that maximize adult return rates, that return adults to suitable habitat, that minimize environmental impacts, and that will be capable of adapting to changing program requirements. The proposed plan that best meets these criteria emphasizes the use of existing facilities. Adult traps that are currently operating or that will be constructed by other agencies will be used, 85% of all program pre-smolts will be produced in three existing hatcheries, and most of the 18 acclimation/release sites have ponds that currently exist. However, to fully meet program objectives, some new facility development is proposed: a small adult holding and incubation site in the Wenatchee subbasin, two constructed habitats for rearing in the Methow subbasin, and a combination of five acclimation sites involve varying degrees of construction. The proposed restoration plan is based on an innovative system of multiple, low cost, natural acclimation sites located near coho habitat. Although this technique is not in wide spread use, it has been well tested during the feasibility phase of the Mid-Columbia and Yakima basin coho restoration projects.

Yakama Nation Fisheries Resource Management will have primary responsibility for implementing the proposed reintroduction plan. Some plan activities, including fish rearing, transportation would be contracted to U.S. Fish & Wildlife Service, Oregon Department of Fish and Wildlife (ODFW), and WDFW. Other activities including facilities planning and design, National Environmental Policy Act (NEPA) analyses, and environmental studies will be contracted to consulting firms.

The project planning schedule supports the phased reintroduction approach and coincides with the Northwest Power and Conservation Council (NPCC) Step process. New facilities are not required in the Broodstock Development phases. Natural Production Phases start in 2011 in the

Wenatchee and 2012 in the Methow. To have the required facilities completed by these dates, construction would begin in 2010 after the completion of the Step 3 review at the end of 2009.

Estimates of the capital and operating costs cover the project's lifetime. Capital cost estimates for the proposed fish facilities system include: program planning; preliminary and final designs; project-level evaluations; facility development permits; land purchase; construction; and capital equipment.

Total MCCRP capital costs

Planning and Design	\$1,040,975
Permits	\$875,355
Capital Equipment	\$1,280,130
Multi-Function Facilities	\$3,473,294
Acclimation Facilities	\$3,252,439
TOTAL	\$9,922,193

Operating expenses include the operation and maintenance of these facilities, as well as the monitoring and evaluation program, and general and administrative project costs. Operating costs will change over time. Expenses during years when release numbers and operating costs are at their maximum are estimated to be:

Peak annual operating expenses (2012)

<u> </u>	
Operation and Maintenance	\$2,282,110
Monitoring and Evaluation	\$1,255,476
Tagging	\$653,417
General and Administrative	\$428,620
SUBTOTAL	\$4,619,623
Cost Share	\$1,211,200
TOTAL	\$3,408,423

The proposed program currently shares rearing costs with National Oceanic and Atmospheric Administration (NOAA) through the Mitchell Act and monitoring and evaluation costs with WDFW and the region's Public Utility Districts (PUDs). Additional funding support may be available in the future through these agencies and others in the region.

CHAPTER 1. BACKGROUND



1255 coho salmon from the Methow River, November 27, 1910. The egg at Twisp and the fry released back to the Methow River. Almost 12 mil 4, representing an average of 360 females per year (3,000 eggs/female), constructed in the lower river, and the hatchery moved downstream. were taken from 1915 to 1920. The average of 194 brood females/year oho between the periods, 1904 to 1914 and 1915 to 1920. No coho eggs word for the periods of the Shafer Museum, Winthrop

Photo courtesy of Shafer Museum, Winthrop, WA. From Mullan, 1992. Production and habitat of salmonids in mid-Columbia River tributary streams.

- 1.1 Purpose of this Plan
- 1.2 Program Vision, Goals, and Guiding Principles
- 1.3 History of Coho
 Reintroduction Efforts
 in the Mid-Columbia
- 1.4 Consistency with Council's Requirements
- 1.5 Relationship to Other Programs in the Region
- 1.6 Decision Process and Schedule
- 1.7 Master Plan Development Team

Chapter 1. Background

1.1 Purpose of this Plan

This Master Plan presents a proposal for the future of coho reintroduction efforts in two mid-Columbia subbasins, the Wenatchee and the Methow. The contents of the plan follow guidelines for master plans as defined by the Northwest Power and Conservation Council (NPCC) (NPCC 2004).

1.1.1 Problem this Program Addresses

The proposed plan seeks to restore coho salmon to the Wenatchee and Methow river basins at biologically sustainable levels that will support harvest in most years. Challenges to coho reintroduction include:

- 1) the absence of locally adapted populations,
- 2) in-basin habitat degradation,
- 3) survival through the migration corridor, and
- 4) variability of ocean environmental conditions.

The proposed reintroduction program directly addresses the first two of the four challenges.

To overcome the absence of a locally adapted population, we build on the feasibility studies that have been conducted since 1996 and present a phased approach to reintroducing coho into the Wenatchee and Methow basins. In this plan, the initial broodstock development phases, begun during feasibility studies, seek to establish a local coho stock, originating from lower Columbia River hatchery stocks, which can return to mid-Columbia tributaries with increasing survival rates. (In 2006, 100% of the coho smolts released in both basins will be progeny of secondgeneration mid-Columbia broodstock). After broodstock development goals are met (see Section 4.3 and Chapter 5), the natural production phases move towards a locally adapted integrated hatchery program where ultimately the percent of natural-origin fish in the hatchery broodstock will exceed the percent of hatchery-origin fish on the spawning grounds (HSRG 2004). Through all the phases, the program proposes to work with other entities in the subbasins to implement habitat improvement and protection projects as identified in the site-specific Implementation Schedule developed for the Upper Columbia Salmon Recovery Board (UCSRB). This schedule of habitat projects will benefit coho as well as the listed species (spring chinook, steelhead, and bull trout) for which the plan was developed. The coho restoration program is designed to be terminated when a self-sustaining naturally reproducing population is established (natural-origin return escapement of more than 1,500 coho to each subbasin, with a terminal and mainstem harvest in most years). This goal is expected to be achieved after five generations of supplementation (by approximately 2026).

1.1.2 Mid-Columbia Coho History

Mid-Columbia coho salmon populations were decimated in the early 1900s by impassable dams, harmful forestry practices, and unscreened irrigation diversions in the tributaries, along with an extremely high harvest rate in the lower Columbia River. The loss of natural stream flow

degraded habitat quality and further reduced coho productivity. Over the years, irrigation, livestock grazing, mining, timber harvest, road and railroad construction, development, and fire management also contributed to destruction of salmon habitat.

Mullan (1983) estimated historical mid-Columbia River adult coho populations as follows:

- Wenatchee—6,000 7,000
- Methow—23,000 31,000
- Entiat—9,000-13,000
- Okanogan—Presence documented but no numbers specified

By the end of the 20th century, indigenous natural coho salmon no longer occupied the mid-Columbia river basins. Since Priest Rapids Dam was completed in 1960, the peak escapement of adult coho upstream of the dam was probably never greater than 10,000 coho and, as of 1998, had not exceeded 1,300 since 1974 (WDFW/ODFW 1998). From 1988 to 1994, adult counts at Priest Rapids Dam averaged only 16 coho, probably a result of releases from Turtle Rock Hatchery, which annually produced about 600,000 coho smolts, until the program was terminated in 1994 (WDFW/ODFW 1995).

For several reasons, self-sustaining coho populations were not established in mid-Columbia basins despite plantings of 46 million fry, fingerlings, and smolts from Leavenworth, Entiat, and Winthrop National Fish Hatcheries between 1942 and 1975:

- The construction and operation of mainstem Columbia River hydropower projects were detrimental to mid-Columbia River salmonid populations. Coho had to pass through a number of dams and reservoirs, leading to deaths from turbines, predation, migration delays, gas bubble trauma, and so forth.
- A substantial amount of critical physical fish habitat was lost or severely degraded (Tyus 1990; Petts 1980; Diamond and Pribble 1978).
- Existing coho programs were unsuccessful or lower priority than programs for other salmonid species. For example, the most recent coho hatchery program in the mid-Columbia region was at Turtle Rock Hatchery, funded by Chelan Public Utility District (CCPUD). The coho program was terminated due to poor adult returns, thought to be caused in part by pathogenic water supplies resulting in disease problems at the hatchery. Because fall chinook and steelhead were higher priority species, they were given priority use of the limited supply of high quality hatchery water. These species currently constitute the program at Turtle Rock. The last coho releases were in 1994.
- Fish culture practices in general resulted in poor adult return rates. Rearing at high densities in concrete raceways, an incomplete understanding of fish health and nutritional needs, the use of water supplies with unnatural temperature profiles, and unacclimated, non-volitional releases directly from hatcheries into the wild environment produced smolts with low survival rates.
- Release locations did not support returns to high quality coho habitat. Releases from hatcheries did not imprint smolts with migratory clues that would encourage them to populate habitats that were far upstream of the release sites.

- Hatchery spawning protocols did not support the development of coho stocks that would be successful in the natural environment and migrate long distances to the upper Columbia basin.
- Harvest was not managed for the protection of weak stocks. Open ocean troll and gill net
 fisheries, the lack of near real-time catch monitoring, and the limited ability to predict run
 sizes resulted in over-harvest of wild fish and weak hatchery stocks.

Since that time, conditions and practices have changed to a certain degree. Some of the local habitat causes of coho depletion have been corrected, although there is still work to be done. For example, many irrigation diversions have been screened, tributary dams have been removed, harvest and harvest management techniques are more capable of protecting upriver stocks, logging practice regulations provide increased environmental protection, mining has ended, and grazing practices have been improved. A few specific examples of projects designed to improve habitat conditions for fish in the target basins include:

Wenatchee Basin:

- improvements in fish passage at Tumwater and Dryden dams
- fish screens at Dryden Dam
- replacement of Chumstick Creek culverts

Methow Basin:

- improvements to the Methow Valley Irrigation District system
- restoration of salmonid habitat in Early Winters and Goat creeks

Similar improvements have been made on the mainstem Columbia.

Another significant change in regional conditions is that the ESA listings of several salmonid species that migrate through the lower Columbia River have curtailed coho fisheries that once over-harvested the mid-Columbia stocks of coho. These fisheries restrictions are likely to be in effect for a number of years.

Recent improvements in artificial production methodology will also improve efforts aimed at supporting natural production. Supplementation techniques, featuring refined genetic objectives, the production of "natural-like" hatchery smolts, and acclimation and release in wild habitat, are being used.

Legally binding Habitat Conservation Plans (HCPs) have been negotiated between fisheries resource managers and Mid-Columbia Public Utility Districts (PUDs). The HCPs have strict performance standards (survival criteria) for both project passage and hatchery compensation so that the hydroelectric projects associated with each HCP can be considered to have No Net Impact on anadromous species.

1.1.3 Local Adaptation

The lack of a locally adapted population may be one of the biggest challenges to coho reintroduction in mid-Columbia tributaries. The Wenatchee Subbasin Plan "Guiding Principle 11" states that reintroduction or supplementation programs should select an appropriate stock or locally adapt a donor stock where a local stock no longer exists (NPCC 2004a). The proposed project is designed to locally adapt a donor stock. While there is an increasing body of literature surrounding the genetic risks of supplementation programs (Busak and Currens 1995; Miller and

Kapuscinski 2003; Ford et al. unpublished manuscript), we have found very little research documenting naturalization or local adaptation of a domesticated hatchery stock.

The lower Columbia River coho stocks originally used during the feasibility phase (project #1996-040-00) are considered a non-local, domesticated hatchery stock. A domesticated hatchery stock is defined as a hatchery stock that has been perpetuated for numerous generations through artificial spawning of returning adult hatchery fish, juvenile rearing, and release (Berejikian and Ford 2004). A domesticated stock has evolved to become more fit in an artificial environment, at the expense of survival or reproductive success in the natural environment (Ford et al. unpublished manuscript).

Domestication is expressed as changes in qualitative traits. Three types of domestication selection have been recognized:

- 1) intentional or artificial domestication selection,
- 2) biased sampling during some stage of culture, and
- 3) unintentional selection (Busak and Currens 1995).

Intentional selection can be reduced by discontinuing selective practices (e.g., using only the early spawners). Control of domestication due to biased sampling depends upon the ability to incorporate random sampling into hatchery procedures.

Reduction of unintentional selection can be more difficult. Busak and Currens (1995) identify two means of reducing unintentional domestication selection.

- a) Selection potentials can be decreased by minimizing the time fish are exposed to the hatchery environment; for example, only wild fish can be used as broodstock so that hatchery fish are regularly cycled through the natural environment (Busak and Currens 1995);
- b) hatchery environments can be made more similar to wild environments (Maynard et al. 1995).

The proposed reintroduction program uses methods to reduce all three types of domestication selection, including those identified by Busak and Currens (1995).

Researchers have demonstrated reduced reproductive success of hatchery fish in natural environments (Miller and Kapuscinski 2003). For steelhead, success of naturally spawning hatchery returns in producing smolt offspring was reported to be 28% of that for wild spawners (Chilcote et al. 1986). Reisenbichler and McIntyre (1977) compared early survival of two-generation-old hatchery stock of steelhead with the wild stock from the same stream. Hatchery fish exhibited a statistically significant survival advantage over wild fish in the hatchery environment, but the situation was reversed in the natural environment. Swain and Riddell (1990) noted that hatchery juvenile coho salmon exhibited more agonistic behavior than wild juveniles. Berejikian and Ford (2004) reviewed 18 studies that directly estimated the relative fitness of hatchery and natural anadromous salmonids; based on this review, the authors concluded that domesticated steelhead, coho, and Atlantic salmon stocks will have low (<30%) lifetime relative fitness in the wild compared to native natural populations.

Without a natural population of coho in mid-Columbia tributaries, the opportunities to incorporate "wild, locally adapted" fish into the broodstock do not exist. To overcome this, we

present a phased approach, where the initial broodstock development phases seek to develop a hatchery stock which can return to mid-Columbia tributaries with increasing survival rates. Next, the natural production phases move towards an integrated hatchery program where ultimately the percent of natural origin fish in the hatchery broodstock (pNOB) will exceed the percent of hatchery-origin fish on the spawning grounds (pHOS) (HSRG 2004).

The All H's Analyzer (AHA) was used to address the loss of fitness that occurs with many hatchery programs. The overarching principles of the proposed management strategy emphasize adherence to genetic, evolutionary and ecological principles, which will result in greater selection pressures from the natural environment than from the hatchery environment (Proportion of natural influence > 0.50) (Mobrand Biometrics).

We are aware of the need for caution when using the AHA or any other single model to generate specific objectives, numerical or otherwise, as described by the ISRP and ISAB (2005). However, project proponents have found minimal literature or empirical data to guide the transition from a non-local domesticated hatchery stock to a population locally adapted to the natural environment. The AHA model provides a framework from which the loss of fitness, or domestication, can be addressed in the form of a working hypothesis. We believe the proposed mid-Columbia coho reintroduction plan presents a unique opportunity to test some of the assumptions of the AHA model, as they pertain to domestication and local adaptation, in the absence of genetic risk¹ to a native coho population.

1.1.4 Habitat Degradation

Currently, many tributaries within the Wenatchee and Methow subbasins lack habitat of sufficient quantity and quality to sustain coho populations with a high enough level of productivity to overcome the reduced survival associated with migrating past 7-9 mainstem dams (EDT Analysis; Mobrand et al. 1997). Therefore, coordination with and support of ongoing habitat restoration efforts are an important component of a comprehensive coho reintroduction plan.

Within both the Wenatchee and Methow Subbasin Plans, coho are listed as a focal species (NPCC 2004a, NPCC 2004b). Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than other focal species. Habitat complexity and off-channel habitats such as backwater pools, beaver ponds and side channels are important for juvenile rearing making coho good biological indicators for these areas (Wenatchee Subbasin Plan p. 71, Methow Subbasin Plan p. 79). Pages 178-179 of the Wenatchee Subbasin Plan describe the relationship of coho salmon to the current status of the habitat and conclude that "natural coho production in the Wenatchee sub-basin could increase if habitat problems within Nason, Icicle, Peshastin, Mission, and Chumstick creeks were improved. Preservation of quality areas in Chiwakum, Little Wenatchee, White and Chiwawa basins would ensure high quality areas remain intact."

Mid-Columbia Coho Restoration Program Master Plan

¹ Genetic risk is the probability of an event or activity having and adverse genetic consequence. Adverse consequences include 1) extinction, 2) loss of within population genetic diversity, 3) loss of among-population genetic diversity, and 4) domestication (Busak and Currens 1995).

1.2 Program Vision, Goals, and Guiding Principles

1.2.1 Vision

The following is the long-term vision for the Mid-Columbia Coho Restoration program.

To re-establish naturally spawning coho populations in mid-Columbia tributaries to biologically sustainable levels which provide significant harvest in most years.

1.2.2 Biological Objectives

Approaches to achieving restoration goals are described in terms of Biological Objectives.

Biological Objective 1: Develop locally adapted, naturally spawning coho stock in the Wenatchee and Methow river subbasins by 2026.

We propose to increase the fitness of reintroduced coho salmon by reducing domestication selection and emphasizing local adaptation. The program will use strict broodstock collection protocols which will incorporate natural origin fish in the broodstock and limit the proportion of hatchery origin adults on the spawning ground. The broodstock collection protocols are intended to manage the broodstock composition to increase the proportion of natural influence (PNI²) in the population with the goal of having a PNI value greater than 0.50; that is, the natural environment must have a greater influence on the population than the hatchery environment. Objective 1 will be considered successful when the following numeric goals have been achieved:

Goal 1. The 3-year mean escapement of natural origin returns in the Wenatchee (upstream of Tumwater Dam) and the Methow river subbasins exceeds 1,500 per subbasin.

This goal is designed to provide the abundance and effective population size required to satisfy the restoration goal without further hatchery supplementation. The figure of 1,500 per basin is supported by results of the AHA calculations which predict a level of sustainability based upon Ecosystem Diagnosis and Treatment (EDT) inputs, estimated capacity, harvest rates, and hydro-system and marine survival.

Goal 2. Achieve a total harvest rate of 23%, which includes a 10% mixed stock harvest, 10% mainstem harvest, and 5% terminal harvest in most years.

Biological Objective 2: Evaluate the efficacy of coho reintroduction in Mid-Columbia tributaries.

We intend to monitor and evaluate the results of reintroduction so that operations can be adaptively managed to optimize hatchery and natural production while minimizing any negative ecological impacts. Pursuing this goal, research data collection and analysis is structured to:

1) demonstrate when the reintroduction program is meeting the established phased restoration goals; 2) determine whether a change in status of sensitive species is occurring and whether it is a result of coho reintroduction; and 3) provide science-based recommendations for management consideration.

² If pNOB is the percent natural origin fish in the hatchery broodstock and pHOS is the percent hatchery origin fish among natural spawners, then PNI= pNOB/(pNOB+pHOS).

Biological Objective 3: Increase the freshwater productivity of coho salmon in the Wenatchee and Methow subbasins.

Currently many tributaries within the Wenatchee and Methow subbasins lack habitat of sufficient quantity and quality to sustain coho populations productive enough to overcome the handicap of passing 7-9 mainstem dams. Therefore, we propose to coordinate and support ongoing and planned habitat restoration within the mid-Columbia as part of a comprehensive plan to restore naturally spawning coho salmon populations. The goal is, within 15 years, to achieve the target productivity values for each tributary that are derived from EDT analysis. Target values for Wenatchee and Methow tributaries are shown in Section 5.4.

1.2.3 Approaches to Achieving Restoration Goals

The proposed plan seeks to achieve the two restoration goals through the following actions, which are summarized in Chapter 4 and detailed in chapters 5-7:

- After initially releasing "domesticated" hatchery fish for reintroduction, the program seeks to increase the fitness of reintroduced coho salmon by reducing domestication selection and emphasizing local adaptation. The program would use strict broodstock protocols that maximize natural-origin adults in the hatchery program and would place a limit on the proportion of hatchery origin returns on the spawning grounds. The AHA model was used as a guide to address the fitness loss that commonly occurs with hatchery programs and that presumably occurred in the lower Columbia River hatchery source stock (see Section 5.4).
- Provide 50% of the cost of a staff member (the other half funded by Pacific Coastal Salmon Recovery Fund [PCSRF]) to identify, propose, solicit funds and implement habitat improvement projects which support habitat restoration in the Wenatchee and Methow rivers. Freshwater productivity of mid-Columbia coho will be improved by implementing habitat restoration projects in key tributaries as identified in the schedule developed for the UCSRB (Section 2.4.4) and by seeking restoration funds through the Habitat Conservation Plan tributary fund (HCP TF), Priest Rapids Settlement Agreement (PRSA), PCSRF, and the Salmon Recovery Funding Board (SRFB).
- Develop a harvest management plan to ensure that exploitation rates are based on survival and abundance forecasts, escapement goals, and are appropriate to changes in abundance caused, for example, by fluctuations in ocean conditions.

1.2.4 Guiding Principles and Mandates

In achieving the vision and restoration goals, the project is guided by the following principles and mandates:

• **Tribal restoration goals.** The Columbia River tribes recognize that fisheries are a basic and important natural resource, of vital concern to them, and that conservation of this resource depends on effective and progressive management. They further believe that by unity of action they can best accomplish these things, not only for the benefit of their own people but for all the people of the Pacific Northwest. The Columbia River treaty tribes believe *Wy-Kan-Ush-Mi Wa-Kish-Wit*, the tribal restoration plan, provides an adaptive management framework to restore the Columbia River salmon, simply stated: **put the fish back into the rivers**.

- A holistic approach to salmon recovery. This guideline incorporates the scientific principles of the Council's 2000 Fish and Wildlife Program (NPPC 2000). The program includes restoring extirpated species and collaboration with others to improve habitat. A restored ecosystem will benefit all species. Specifically, restoring coho salmon may provide much-needed nutrients for aquatic and terrestrial animals at the onset of winter when food sources may be scarce. Restored habitats should result in increased productivity for all salmonid species.
- Northwest Power and Conservation Council principles, objectives and strategies for artificial production projects. NPCC recommends artificial production under the proper conditions including:
 - 1) complementing habitat improvement by supplementing fish populations up to the sustainable carrying capacity with fish that are as similar as possible in genetics and behavior to wild native fish, and
 - 2) replacing lost salmon or steelhead populations.

Further, the NPCC supports an "experimental adaptive management approach that includes an aggressive program to evaluate the risks and benefits and addresses scientific uncertainties." (NPPC 2000)

- The principles, objectives, and processes defined in the Treaty of 1855 and *U.S. v. Oregon*. In the Treaty of 1855, bands and tribes of the Yakama Nation reserved "[t]he exclusive right of taking fish in all the streams running through or bordering [their] reservation...and...taking fish at all usual and accustomed places..." The *United States versus Oregon* treaty fishing rights case affirmed that the 1855 treaty reserved for the tribes a fair share of the harvest, which was subsequently determined to be 50% of the harvestable portion of runs destined to pass the tribes' usual and accustomed fishing areas. The *U.S. v. Oregon* decision also established guidelines and procedures by which the tribes could function as self-regulating fishery co-managers together with the state and federal fishery agencies. The Yakama Nation views the *U.S. v. Oregon* process as the expression of its co-management authority and, therefore, the primary forum through which the tribe's management goals and priorities should be advanced.
- The principles and process requirements of environmental laws, including the Endangered Species Act and National Environmental Policy Act. Program proponents seek to meet coho restoration goals without harming natural or human resources. A key focus of the program is to minimize potential competitive impacts with sensitive species—Non-Target Taxa of Concern or NTTOC. These species are defined as spring chinook salmon, steelhead, and bull trout—species listed under the Endangered Species Act (ESA)—and sockeye salmon. The program would meet these principles by assuming a finite timeline for supplementation activities; emphasizing local adaptation that results in self-sustaining natural coho populations; and monitoring the size, abundance and distribution of sensitive species as they relate to coho reintroduction activities. Before site-specific decisions are made, future processes would thoroughly analyze the program's effects on species and resources of all kinds.
- Visions and goals of the Wenatchee and Methow subbasin plans. Coho are identified as a focal species in both subbasin plans. In the Wenatchee plan, Goal 3 is to "[r]estore, maintain, or enhance fish and wildlife populations to sustainable and harvestable levels, while protecting biological integrity and the genetic diversity of the species." (NPCC

2004a) In the Methow plan, "[t]he goal for coho salmon includes re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses, and harvestable surpluses." (NPCC 2004b)

• The need to minimize program costs while ensuring sufficient resources to meet program goals effectively. Yakama Nation (YN) recognizes that many fish restoration projects throughout the region compete for limited funds. Therefore we present a time-limited plan that emphasizes the use of existing facilities to restore coho salmon while partnering with other programs, sharing resources with other agencies, and adapting the program in response to monitoring and evaluation.

1.3 Mid-Columbia Coho Reintroduction Project Documents

Since 1996, the Bonneville Power Administration (BPA) has been funding ongoing studies and artificial production of coho salmon (*Oncorhynchus kisutch*) in the Wenatchee and Methow river basins, in the state of Washington. The purpose was to determine the feasibility of reintroducing self-sustaining coho populations in the mid-Columbia region. The work is being conducted primarily by the YN, with significant assistance from other state, federal, and public utility participants.

1995 - 1997

This project was formally established by the Yakama Nation with the adoption of the Tribal Restoration Plan in 1995 (CRITFC 1995) by the four Columbia River treaty tribes (Nez Perce, Umatilla, Warm Springs, and Yakama).

In April 1996 the project was one of the 15 high priority supplementation projects recommended for funding by the Northwest Power Planning Council (NPPC) [now Northwest Power and Conservation Council] and was incorporated into the Fish and Wildlife Program (program measures 7.1H, 7.4A, 7.4F, and 7.4O) (as documented in NPPC 1994). These high priority supplementation projects were forwarded with strong endorsements from both the *U.S. v. Oregon* Policy Committee and the National Marine Fisheries Service (NMFS).

The coho project was developed in two phases. Phase I was experimental, as it evaluated feasibility, ecological interaction, survival through the system and broodstock development. Phase II was to focus on production and restoration activities.

In the FY 1998 Annual Implementation Work Plan (AIWP), the Council recommended funding for completion of the environmental review of Phase I. Since this phase of the project was initiated prior to the Council's Three-Step Review Process and was experimental in nature, no step review was necessary (M. Fritsch, NPPC, memorandum to Council, July 12, 2000).

1998

Spring: BPA determined that acclimation and release of coho smolts for research purposes at four sites in the Methow basin was categorically excluded from National Environmental Policy Act (NEPA) analysis.

Fall: A comprehensive research program was proposed (YIN 1998).

1999

April: BPA analyzed environmental impacts of the research project in the Mid-Columbia Coho Reintroduction Feasibility Project Final Environmental Assessment (EA) (USDOE/BPA 1999b). The EA analyzed impacts of research to determine the feasibility of reintroducing naturally reproducing coho into the Methow and Wenatchee river basins, from which they have been extirpated. The EA focused on the impacts of construction of coho acclimation facilities, of coho smolt releases, of monitoring their survival and interactions with other species, and of operation and modification of existing production facilities needed to conduct the research. Effects of that plan on species listed under the ESA also were analyzed in Biological Assessments (BAs) submitted to U.S. Fish and Wildlife Service (USFWS) and to NMFS.

December: The project was further refined in the Hatchery and Genetics Management Plan (HGMP) (YN et al. 1999), required by NMFS in its Biological Opinion.

Annual report: Dunnigan, J. 1999. Feasibility and risks of coho reintroduction in mid-Columbia Tributaries: **1999 annual monitoring and evaluation report,** project No. 1996-040-000. Bonneville Power Administration, Portland, OR. [covers 1998 and 1999]

2000

July: A Partial Step 2 Review for NPPC was completed. The review was requested as part of the Fiscal Year 2000 Annual Implementation Work Plan that was triggered by YN's decision to switch the emphasis of this project from the Methow to the Wenatchee basin. It led to requirements that a future plan for the project would need to address (see Section 1.4.2 of the Master Plan).

Annual reports:

Murdoch, K.G. 2001. Mid-Columbia Coho Reintroduction Feasibility Project: **2000 Acclimation Report**. Prepared for: Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G., and J.L. Dunnigan. 2002. Feasibility and risks of coho reintroduction in mid-Columbia River tributaries: **2000 annual report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2001

April: BPA prepared a Supplement Analysis to evaluate additional research activities, temporary incubation and rearing facilities at the Two Rivers acclimation site, and potential additional acclimation sites not evaluated in the EA (USDOE/BPA 2001b).

October: BPA prepared a Supplement Analysis to analyze the effects of using an existing building near Peshastin, Washington for a temporary site to incubate coho eggs for the program (USDOE/BPA 2001d).

Annual reports:

Murdoch, K.G. and C.M. Kamphaus. 2003. Mid-Columbia-Coho Reintroduction Feasibility Project: **2001 Annual Broodstock Development Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G, and M.L. Larue. 2002. Feasibility and risks of coho reintroduction in mid-Columbia River tributaries: **2001 annual report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2002

March: BPA categorically excluded the dredging of an existing pond behind Dam 5 at Leavenworth National Fish Hatchery (NFH) to improve its effectiveness as an acclimation site.

November: BPA prepared a Supplement Analysis to evaluate the effects of adding several new acclimation sites for the project (USDOE/BPA 2002).

- ➤ <u>Leavenworth NFH</u>: The project proposed use of and improvements to existing, unused Foster-Lucas ponds at Leavenworth NFH and construction of an improved water delivery system on hatchery grounds to partially replace the acclimation pond behind Dam 5, which would be unavailable after 2003.
- Nason Creek subbasin: The project proposed three new acclimation sites in the Nason Creek subbasin to help acclimate the remainder of the coho smolts programmed for the Wenatchee basin. The sites were:
 - Coulter Creek: Installation of an outlet pipe through a beaver dam, and seasonal installation and removal of nets across a beaver pond located on privately owned land, to allow acclimation and release of up to 100,000 coho smolts.
 - Whitepine Beaver Pond: Seasonal installation and removal of nets across a beaver pond on U.S. Forest Service (USFS) land, and clearing and graveling an overgrown logging road to provide vehicle access to a footpath, which would then allow access to the pond. From 50,000 to 100,000 smolts would be acclimated and released from this site. The site was never used.
 - Mahar Creek Pond (now called Rohlfing): Seasonal installation and removal of nets across an existing pond on privately owned land. From 50,000 to 100,000 smolts would be acclimated and released from this site.
- ➤ <u>Little Wenatchee (Two Rivers)</u>: Within the previously evaluated area at an existing gravel pit (USDOE/BPA 1999b), the project proposed to use an existing discharge channel as a coho acclimation pond.
- ➤ <u>Chumstick Creek</u>: The project proposed a direct stream release of smolts, instead of acclimation as discussed in DOE/BPA 2001b.

December: The HGMP was updated, in consultation with project participants (YN et al. 2002). **Annual reports:**

Kamphaus, C.M., and K.G. Murdoch. 2004. Mid-Columbia Coho Reintroduction Feasibility Study: **2002 Annual Broodstock Development Report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

Murdoch, K.G., C.M. Kamphaus, and S.A. Prevatte. 2004. Feasibility and risks of coho reintroduction in mid-Columbia tributaries: **2002 Annual Monitoring and Evaluation Report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2003

July: BPA received concurrences from USFWS (letter dated July 31, 2003 from Mark G. Miller, Supervisor, Contral Washington Field Office) and NOAA Fisheries (letter dated June 23, 2003 from D. Robert Lohn, Regional Administrator) on expansion of the Mahar Creek acclimation pond and construction of the Two Rivers acclimation pond.

August: A Supplement Analysis was prepared to examine the impacts of expanding the Mahar Creek acclimation pond (USDOE/BPA 2003).

October: Final Biological Opinion covering the Mid-Columbia Coho Project (plus other upper Columbia artificial production projects) was issued. ESA Section 7 Consultation 1999/01883, issued October 22, 2003.

Annual reports:

- Kamphaus, C.M. and K.G. Murdoch. 2005. Mid-Columbia Coho Reintroduction Feasibility Study: **2003 Annual Broodstock Development Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.
- Murdoch, K.G., C.M. Kamphaus, and S.A. Prevatte. 2005. Mid-Columbia Coho Reintroduction Feasibility Study: **2003 Annual Monitoring and Evaluation Report**. *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2004

Annual reports:

- Kamphaus, C.M. and K.G. Murdoch. *In Prep.* Mid-Columbia Coho Reintroduction Feasibility Study: **2004 Annual Broodstock Development Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.
- Murdoch, K.G., C.M. Kamphaus, and S.A. Prevatte. *In Prep.* Mid-Columbia Coho Reintroduction Feasibility Study: **2004 Annual Monitoring and Evaluation Report.** *Prepared for:* Bonneville Power Administration, Project # 1996-040-00. Portland, OR.

2005

September: BPA categorically excluded minor modifications to the acclimation pond on the Rohlfing property (formerly called the Mahar Creek acclimation pond).

1.4 Consistency with Council's Requirements

1.4.1 Master Planning Guidelines

In accordance with Section 7.4B of the Fish and Wildlife Program (NPPC 1994), this master plan addresses Council master planning guidelines in the locations listed below.

Council Requirement 1

Address the relationship and consistencies of the proposed project to the eight scientific principles.

Principle 1. The abundance, productivity and diversity of organisms are integrally linked to the characteristics of their ecosystems.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2, 6.3, 7, Appendix A, B.1, B.2

Principle 2. Ecosystems are dynamic, resilient and develop over time.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 7

Principle 3. Biological systems operate on various spatial and time scales that can be organized hierarchically.

See Sections 1.1, 1.5, 2.2, 2.4, 5.3, 5.4

Principle 4. Habitats develop, and are maintained, by physical and biological processes.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2

Principle 5. Species play key roles in developing and maintaining ecological conditions.

Each species has one or more ecological functions that may be key to the development and See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4

Principle 6. Biological diversity allows ecosystems to persist in the face of environmental variation.

See Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4

Principle 7. Ecological management is adaptive and experimental.

See Sections 1.2, 1.5, 3.2, 4.2, 4.3, 5.4, 6.2, 7

Principle 8. Ecosystem function, habitat structure and biological performance are affected by human actions.

Sections: 1.1, 1.2, 1.5, 2.1, 2.2, 2.3, 2.4, 3.1, 3.2, 4.1, 4.2, 4.3, 4.5, 5.3, 5.4, 6.2, 6.3, 7, Appendix A, B.1, B.2

Council Requirement 2

Describe the link of the proposal to other projects and activities in the subbasin and the desired end state condition for the target subbasin.

Section 1.5 and 2.4.4.

Council Requirement 3

Define the biological objectives with measurable attributes that define progress, provide accountability and track changes through time associated with this project.

Section 1.2.2, Section 4.3.1, Chapter 5, Chapter 7.

Council Requirement 4

Define expected project benefits (e.g. preservation of biological diversity, fishery enhancement, water optimization, and habitat protection).

Section 1.2, 2.4.4, 4.3.6, 4.5.

Council Requirement 5

Describe the implementation strategies as they relate to the current conditions and restoration potential of the habitat for the target species and the life stage of interest.

Section 2.4, 4.3, Chapter 5.

Council Requirement 6

Address the relationship to the habitat strategies.

Section 1.2.2, 2.4, 4.3, 5.5.

Council Requirement 7

Ensure that cost-effective alternate measures are not overlooked and include descriptions of alternatives for resolving the resource problem, including a description of other management activities in the subbasin, province and basin.

Section 1.5, 2.4.4, 4.2, Chapter 6, B and C appendices.

Council Requirement 8

Provide the historical and current status of anadromous and resident fish and wildlife in the subbasin most relevant to the proposed project.

Section 2.2 and 2.3.

Council Requirement 9

Describe current and planned management of anadromous and resident fish and wildlife in the subbasin.

Section 1.5, 2.2, 2.3.

Council Requirement 10

Demonstrate consistency of the proposed project with NOAA Fisheries recovery plans and other fishery management and watershed plans.

Section 1.5, 2.4.4, 5.5.

Council Requirement 11

Describe the status of the comprehensive environmental assessment.

Section 1.3. 1.6.

Council Requirement 12

Describe the monitoring and evaluation plan.

Section 4.3.3, Chapter 7.

Council Requirement 13

Describe and provide specific items and cost estimates for 10 Fiscal Years for planning and design (i.e. conceptual, preliminary and final), construction, operation and maintenance and monitoring and evaluation.

Chapter 8, Appendix D.

Council Requirement 14

Address the relation and link to the Council's artificial production policies and strategies.

Section 4.3.2, 5.3, 5.4.

Council Requirement 15

Provide a completed Hatchery and Genetic Management Plan (HGMP) for the target population(s).

Appendix G.

Council Requirement 16

Describe the harvest plan.

Chapter 5, AHA calculations.

Council Requirement 17

Provide a conceptual design of the proposed facilities, including an assessment of the availability and utility of existing facilities.

Chapter 6 and Appendices B.1, B.2, C.1 – C.4.

1.4.2 Partial Step 2 Review

This section discusses where the Master Plan addresses the information needs identified in the Partial Step 2 review. As stated in the July 12, 2002 memorandum: "The results of Phase I will be used to address program areas pertaining to master planning as well as other aspects including National Environmental Policy Act documents. Before initiation of Phase II, this information will be used for a Step 2 review." (M. Fritsch, NPPC, memorandum to Council, July 12, 2000). The following four categories of information (in boldface type) were requested for the next Council review of the Mid-Columbia coho project. The location of this information in the Master Plan follows each category (in regular typeface).

1) Provide a specific statement of goals in terms of numbers of coho adults and/or of smolt to adult return rates that are expected to constitute success in reestablishment or at least to render unnecessary further hatchery plants or supplementation with artificially reared coho.

Section 1.2.2, Chapters 4 and 5.

2) Modify monitoring and evaluation procedures to clarify how time-limited objectives will be measured.

Chapter 7.

3) Discuss the possibility that further facilities may not be needed and the conditions that would enter into making that decision.

Chapter 6 and Appendices B.1, B.2, C.1 - C.4

- 4) Respond to the general and specific comments relating to:
 - harvest rates as limiting factors (Chapter 5, AHA calculations, Section 7.1.10)
 - the monitoring and evaluation plan (Chapter 7)
 - issues (i.e. ecological interactions, quality of rearing habitat and case studies of successes in similar endeavors).
 - Ecological interactions: Sections 3.2, 7.2.
 - o Quality of rearing habitat: Section 2.4, Chapter 5.
 - Case studies: Section 4.5

1.5 Relationship to Other Programs, Projects, and Plans in the Region

1.5.1 Treaty of 1855 and *U.S. v. Oregon*

In the Treaty of 1855, bands and tribes of the Yakama Nation reserved "[t]he exclusive right of taking fish in all the streams running through or bordering [their] reservation...and...taking fish at all usual and accustomed places..." "The treaty right to take fish in usual and accustomed places requires that fish runs pass such usual and accustomed places" (S. Jim and P. Rigdon, YN, letter to M. Eden, NPCC, August 25, 2005).

In the westward expansion of the United States during the 19th century, Congress required that federal representatives treat with and compensate native peoples who were then occupying the lands that were desired for inclusion in the Union. In the Treaty of 1855, 14 independent tribes and bands occupying roughly the central third of Washington State were confederated into the Yakama Nation. In exchange for ceding their ancestral lands to the United States so that they could lawfully be opened to settlement, tribal leaders secured in perpetuity certain rights and privileges that were considered necessary to preserve tribal culture and traditions. Among these reserved rights was the exclusive right to fish in rivers running through and bordering the new Yakama Reservation, and "in common with" residents of the territory at all "usual and accustomed" fishing areas. The Treaty of 1855 was ratified by Congress in 1859 and became recognized as "the supreme law of the land."

As increasing numbers of non-Indians began to develop agricultural, industrial, and fishery resources of the Columbia Basin, tribal fishers saw their Treaty-reserved fisheries steadily decline over the ensuing century. In 1968, several members of the Yakama Nation filed suit against the United States for failing to preserve and protect their access to fisheries reserved in the Treaty of 1855. The United States, on behalf of the Columbia River Treaty Tribes, filed suit against the State of Oregon for allowing non-treaty fisheries to harvest virtually all harvestable portions of Columbia River runs while restricting Treaty fisheries in order to meet escapement goals. The *United States versus Oregon* treaty fishing rights case affirmed that the 1855 treaty reserved for the tribes a fair share of the harvest, which was subsequently determined to be 50% of the harvestable portion of runs destined to pass the tribes' usual and accustomed fishing areas.

The *U.S. v. Oregon* decision also established guidelines and procedures by which the tribes could function as self-regulating fishery co-managers together with the state and federal fishery agencies. Under continuing Court oversight, a co-management process was created that provides for joint technical and policy review of management proposals by tribal, state, and federal parties to the lawsuit. This process is intended to ensure that Treaty and non-Treaty fishery regulations are consistent with harvest sharing principles and with rebuilding the upriver runs. The Yakama Nation views the *U.S. v. Oregon* process as the expression of its co-management authority and, therefore, the primary forum through which the tribe's management goals and priorities should be advanced.

The *U.S. v. Oregon* process is implemented through harvest and hatchery management plans that are jointly developed by the parties and become binding on them when adopted as Court orders. Harvest management plans are negotiated within the *U.S. v. Oregon* process and describe the management goals and guidelines that shape in-season harvest management. Hatchery management plans may be negotiated within the *U.S. v. Oregon* process or they may be brought into the process as plans jointly prepared by the relevant co-managers in a separate forum, such as a FERC hydro project licensing process. Once adopted into the *U.S. v. Oregon* management plan, these production plans become binding on the co-managers and cannot be unilaterally altered.

1.5.2 Columbia River Fish Management Plan (U.S. v. Oregon)

As stated in Section 1.5.1, *U.S. v. Oregon*, which remains under Court jurisdiction, upheld the treaty fishing rights of the Columbia River treaty tribes in a 1969 decision. In 1983, the court ordered the tribes, states and the federal government to develop a management plan, named the Columbia River Fish Management Plan (CRFMP). The purpose of the CRFMP is to protect, rebuild, and enhance upper Columbia fish runs while providing harvest for both Treaty Indian and non-Indian fisheries. Consistent with III.D.4 of the CRFMP, the All Species Review of the CRFMP (TAC 1997) states that the Parties continue to provide for coho production opportunity in natural areas of the upper Columbia compatible with natural production. "Possible sites include: Grande Ronde, Walla Walla, upper Yakima, Naches, and tributaries of the Clearwater, Wenatchee, Methow, and Entiat rivers."

"Perhaps most significantly, the *US v. Oregon* framework provides the backdrop for the development and implementation of the Council's FWP [Fish and Wildlife Program]. Indeed, because the *US v. Oregon* process promotes exercise of the Yakama Nation's treaty rights, the Northwest Power Act ("the Act") requires that [the] FWP and implementing activities be consistent with *US v. Oregon* requirements. *See, 16 U.S.C. Sec. 839b(h)(6).*" (S. Jim and P. Rigdon, YN, letter to M. Eden, NPCC, August 25, 2005).

This proposed Master Plan would assist in meeting the Parties' (Yakama, Nez Perce, Umatilla and Warm Springs tribes; USFWS, NOAA, BIA, ODFW, WDFW, and IDFG) intent under the auspices of *U.S. v. Oregon*.

1.5.3 Mitchell Act

The Mitchell Act authorized the Secretary of Commerce to implement the construction of salmon hatcheries in Oregon, Washington, and Idaho as a means to mitigate for salmon production lost as a result of the construction of the federal Columbia River hydro-power system. Most of the Mitchell Act hatcheries were constructed in the lower Columbia River in the 1950s and 1960s. Only since 1988, under the jurisdiction of *U.S. v. Oregon*, have lower Columbia River Mitchell Act hatcheries been reprogrammed³ to provide coho salmon smolts for release in upriver areas, including the Wenatchee and Methow basins. Smolts grown at these hatcheries, which are offspring of coho that returned to the mid-Columbia, provide the basis for reintroduction efforts in these two Columbia River basins. Up to 90% of the coho salmon proposed for release in this Master Plan will be reared in Mitchell Act facilities.

1.5.4 Wy-Kan-Ush-Mi Wa-Kish-Wit: Spirit of the Salmon Tribal Recovery Plan

This plan (CRITFC 1995) was developed by the four Columbia River Treaty Tribes (Nez Perce, Umatilla, Warm Springs, and Yakama). It is a comprehensive plan put forward by the Tribes to restore anadromous fishes to rivers and streams that support the historical cultural and economic practices of the tribes. *Wy-Kan-Ush-Mi Wa-Kish-Wit* provides the basic goal to restore the Columbia River salmon, which is, simply: **put the fish back into the rivers**. The proposed

³ The word "reprogrammed" results from the fact that fish produced at a hatchery have a specific release program as part of their facility's management plan. Historically, most hatcheries, especially in the lower Columbia River released their juveniles on-station. The Tribes took the operating agencies to court (*U.S. v. Oregon*) to get the production "reprogrammed" and released above Zone 6 (Tribal fishing zone) so that the fish would be imprinted to locations above their fishery.

Master Plan meets the goals and objectives of the tribal restoration plan for coho restoration in the Wenatchee and Methow rivers.

1.5.5 Wenatchee and Methow Subbasin Plans

The proposed Mid-Columbia Coho Restoration Project is consistent with and supports the vision and goals of both the Wenatchee and Methow subbasin plans. The vision for the Wenatchee Subbasin includes restoring extirpated fish and wildlife, and natural habitats that perpetuate native fish wildlife and fish populations into the foreseeable future. The vision for the Methow subbasin is to support self-sustaining, harvestable, and diverse populations of fish and wildlife.

Restoring extirpated fish and wildlife is a specific goal and priority to advance the vision of the Wenatchee Subbasin Plan, and is also a specific goal of the Methow Subbasin Plan: "The goal for coho salmon includes re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses, and harvestable surpluses." (NPCC 2004b) BPA Project #1996-040-00 is the only project currently working toward these goals in mid-Columbia tributaries. The proposed master plan represents a strategy to re-establish coho runs in five generations of supplementation by emphasizing increased fitness through local adaptation and increased productivity through coordinated habitat improvement.

In both the Wenatchee and Methow subbasin plans, coho salmon are listed as a focal species. Many of the prioritized habitat restoration actions in the subbasin plans are aimed at supporting continued restoration of coho populations. Coho salmon prefer and occupy different habitat types than the other focal species, selecting slower velocities and greater depths. Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing, making coho salmon a good biological indicator for habitat recovery prioritized in the subbasin plans.

The following excerpts from the two subbasin plans are a sample of how coho have been incorporated into the plans. To highlight the issues, we have added emphasis within the quotations.

• Methow Subbasin Plan excerpts:

<u>Page xxi, Section 1 Fisheries Management:</u> This section provides the Methow Subbasin Plan goals for focal species. "**The goal for coho salmon includes re-establishment of run sizes that provide for species recovery, mitigation of hydro-system losses, and harvestable surpluses."**

<u>Page 33, section 3.3.1 Fish Focal Species: Population Characterization and Status:</u> "A focal species has special ecological, cultural, or legal status and represents a management priority in the Methow subbasins and, by extension, in the Columbia Cascade Eco-province. Focal species are used to evaluate the health of the ecosystem and effectiveness of management actions." The inclusion of coho salmon as a "focal species" in the Methow Subbasin Plan clearly indicates that continued coho restoration is consistent with the Plan, and that coho can be used as an indicator species for select habitat types.

<u>Page 79 Section 3.4.6 Fish Focal Species, Rationale for Selection – Coho:</u> "Historically the Methow River produced more coho than chinook or steelhead (Craig and Suomela 1941). Mullan (1984) estimated that 23,000-31,000 coho annually returned to the Methow River. Upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat (Mullan 1984). Today coho

reintroduction is identified as a priority in the *Wy-Kan-Ush-Mi Wa-Kish-Wit* document (Tribal Restoration Plan) and has been affirmed as a priority by the Northwest Power and Conservation Council."

"Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than other focal species: Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing making coho good biological indicators of these areas."

"While the historic stock of coho salmon are considered extirpated in the Upper Columbia River, ... [i]n cooperation with the WDFW and the USFWS, the Yakama Nation is currently leading coho salmon recovery efforts in the basin."

<u>Page 79 Section 3.4.6 Fish Focal Species, Coho – Representative Habitat:</u> "Currently, coho salmon returning to the Methow Basin are spawning in the mainstem Methow River and small tributaries such as Gold Creek. **As the recovery program continues, reintroduction of coho to tributaries within the Methow Basin will aid in species dispersal."** This statement indicates that continued coho reintroduction is expected in the Methow Subbasin Plan to ensure adequate species dispersal within the Methow Subbasin.

<u>Pages 79-80 Section 3.4.6 Fish Focal Species, Coho – Key Life History Strategies,</u> <u>Relationship to Habitat:</u> This section provides detailed information from both the literature and YN's coho reintroduction program regarding Upper Columbia River coho life history strategies and relationship to the habitat.

<u>Page 81 Section 3.4.6 Fish Focal Species, Coho – Population Status:</u> "Coho salmon returning to the Methow Basin are primarily hatchery origin, but include an increasing naturally produced component as a result of ongoing reintroduction efforts."

<u>Page 81 Section 3.4.6 Fish Focal Species, Coho – Population Management Regimes and Activities:</u> "The ideal result would be to restore coho populations in these basins [Methow and Wenatchee] to their historic levels. Because of varying degrees of habitat degradation in each of these basins, historical numbers are unlikely ever to be achieved but remain a goal towards which to strive."

<u>Pages 81-83 Section 3.4.6 Fish Focal Species, Coho:</u> These pages contain detailed descriptions of coho hatchery effects (history of coho programs and current programs), hydro-electric effects (GCFMP programs and Chelan and Douglas PUD HCP obligations to coho salmon), and harvest effects.

<u>Pages 301-353 Section 5.5 Assessment Unit Summaries:</u> Within section 5.5 coho salmon are specifically listed as a focal species for the following Assessment Units: Lower Methow, Middle Methow, Upper-Middle Methow, Upper Methow/Early Winters/Lost River, Black Canyon/Squaw Creek, Gold/Libby Creeks, Beaver/Bear Creeks, Lower Twisp River, Upper Twisp River, Upper Chewuch River, Lower Chewuch River, Goat/Little Boulder Creeks. As a focal species in these Assessment Units, much of the recommended restoration strategies should improve habitat for coho. The geographic distribution of coho as a focal species within the Subbasin Plan is consistent with the proposed coho master plan.

• Wenatchee Subbasin Plan excerpts:

<u>Page xxi, Section 2.5.2 Key Findings: Aquatic:</u> "Limiting factors are defined as a habitat element that limits the biological productivity and/or life history diversity of a focal species. **The focal species selected for this assessment include spring chinook salmon, late-run chinook salmon, sockeye salmon, coho salmon,** steelhead trout, bull trout, westslope cutthroat trout, and pacific lamprey." As defined in the plan "focal species will be used to evaluate the health of the ecosystem and the effectiveness of management actions." The inclusion of coho salmon as a 'focal species' in the Wenatchee Subbasin Plan clearly indicates that continued coho restoration is consistent with the Plan, and that coho can be used as an indicator species for select habitat types.

<u>Page 26, Section 3.3.3 Guiding Principle-8</u>: "Species diversity and the biotic community are a reflection of the ecosystem attributes. The co-evolved assemblage of species share requirements for similar ecosystem attributes and those attributes can be estimated by intensive study of **focal** or indicators species." Coho salmon are a focal species in the Wenatchee Subbasin Plan. They are part of the co-evolved assemblage of species. The only way to increase species diversity with co-evolved species is to restore those species which have become extirpated or limited on a geographic scale. The Subbasin Plan states that coho are a good indicator species for off-channel habitats.

<u>Page 27, Section 3.3.3 Guiding Principle 10:</u> "Restoration of individual populations may not be possible without restoration of other fish and wildlife populations with which they co-evolved." We interpret this statement from the 10th guiding principle to directly apply to the reintroduction of coho salmon (extirpated species) which co-evolved with all the other focal species in the basin. The plan acknowledges that restoration of ESA species may not be possible unless the ecosystem and co-evolved fish assemblage is restored.

<u>Page 27, Section 3.3.3 Guiding Principle 11</u>: "Reintroduction [coho] or supplementation [chinook and steelhead] programs for fish and wildlife should concentrate on specific environments within the basin, **selection of an appropriate stock for reintroduction to that environment or locally adapting a donor stock [coho] where a local stock no longer exists.**" This statement from the 11th guiding principle describes the strategies of the coho reintroduction program. YN's coho reintroduction program is the only program in the basin where a local stock is not available and is "developing a locally adapting donor stock." This guiding principle supports YN's reintroduction approach.

<u>Page 28, Section 3.3.3 Guiding Principle 12</u>: "At some point along the scale from intact population to former populations that have had entire metapopulations extirpated from the basin and adjacent basins, emphasis on recovery actions is better focused on rebuilding population structure than on habitat restoration. If the goal of cost-effective restoration is to be achieved, subbasin planners need to assess the optimal mix of habitat restoration and population structure restoration to achieve biological goals."

<u>Page 29, Section 4.1 Focal Species – Aquatic/Fish:</u> "Fish focal species were defined that a) have special cultural significance, b) fulfill a critical ecological function, c) serve as an indicator of environmental health, d) are locally significant or rare as determined by applicable state or federal resource management agencies and/or are federally listed. Eight anadromous and resident fish species were chosen as focal species. Each of these species is considered to be culturally important, three of the species are listed under ESA and each

species uniquely represent different and important habitat characteristics." Coho salmon are a focal species in the Wenatchee Subbasin Plan.

<u>Page 29 Section 4.1 Focal Species – Table 12</u>: Within table 12, coho are shown as a focal species with a representative habitat of "lower mid-elevation mainstem and tributaries, side channel and backwater environments." Lower and mid-elevation mainstem includes the Wenatchee River from the mouth to the Lake. Tributaries include Nason Creek, Chiwawa River, White River, and Little Wenatchee.

<u>Page 70 - Figure 11</u>: The figure on page 70 shows the **current** distribution of coho in the Wenatchee subbasin. At the bottom of the figure the following note is found – "**Note: Coho presence and spawning information is dynamic and is expected to change significantly each year as reintroduction efforts continue." The Wenatchee Subbasin Plan expects coho reintroduction to continue.**

Page 71 Section 4.8.5 Coho (Oncorhynchus kisutch) – Rationale for Selection: "Coho salmon were once considered extinct in the mid-Columbia region, but have since been reintroduced. Recent re-introduction efforts have resulted in natural reproduction occurring in the basin. Mullan (1984) estimated the historical run size at 38,000 to 51,000 adults to the Wenatchee, Entiat, and Methow Rivers (Peven 2003). Recently the Yakama Nation has begun a substantial and concerted effort to reintroduce coho into the upper Columbia, using the Wenatchee and Methow subbasins during the feasibility phase of this work. Coho salmon prefer and occupy different habitat types, selecting slower velocities and greater depths than the other focal species. Habitat complexity and off-channel habitats such as backwater pools, beaver ponds, and side channels are important for juvenile rearing making coho good biological indicators for these areas."

<u>Page 178 Section 6.3.2 Aquatic/Fish Summary of Environmental/ Population Relationships of the Focal Species – Coho:</u> Pages 178-179 describe the relationships of coho salmon (focal species) to the current status of the environment. Selection highlights are reported below:

"Spawning areas for coho salmon in Nason Creek have been compromised by loss of riparian area and subsequent large wood recruitment, off channel habitats, channel stability, and general diversity... Coho spawning habitat in the Little Wenatchee River remains in good condition. Coho spawning also occurs in the Wenatchee River and Icicle Creek where increases in sediment deposition, channel confinement and higher flow rates have most likely reduced incubation success. Largely unaltered coho spawning habitat exists in the Chiwawa and White Rivers."

"Natural coho production in the Wenatchee subbasin could increase if habitat problems within Nason, Icicle, Peshastin, Mission, and Chumstick creeks were improved. Preservation of quality habitat areas in Chiwakum, Little Wenatchee, White, and Chiwawa basins would ensure high quality areas remain intact."

These conclusions within the subbasin plan indicate that YN's long-term plan is consistent with the findings in the Subbasin Plan in regards to tributaries containing coho habitat within the Wenatchee basin.

<u>Page 305 Section 7.8.16 Summary of Near-term Opportunities by Focal Species – Coho</u>
<u>Salmon:</u> "Continued development of a locally adapted broodstock is essential to ensure future populations of naturally spawning coho salmon in the Wenatchee River.

Increased habitat diversity (e.g., off channel habitat, increased structural diversity, etc) primarily in Nason Creek, Peshastin Creek, Mission Creek, and the lower Wenatchee River would increase the success of naturally spawning coho and increase productivity. Evaluation of migrational delays in Tumwater Canyon could improve extreme flow passage conditions for adults migrating to the upper Wenatchee subbasin."

This section clearly states that the continued coho broodstock development is not only consistent with the subbasin plan but "essential" for the restoration of coho salmon in the Wenatchee subbasin.

1.5.6 Yakima River Coho Restoration

The Yakima Coho restoration project is a component of the Yakima/Klickitat Fisheries Project (YKFP). The Yakama Nation is the lead agency in both Mid-Columbia and Yakima restoration projects. Both are high-priority NPCC projects, are in the Tribal Recovery Plan, are legally binding under *U.S. v. Oregon*, and have similar overall goals. Personnel from both projects meet as needed to review feasibility progress and results. Several studies in both projects have interbasin application. For example, the predation studies of coho on sensitive species completed in both projects confirmed minimal interactions between coho and other salmonids. Both projects adaptively manage in response to results and peer review. Joint meetings of the two projects are held annually to coordinate objectives, production, research needs, and monitoring results.

1.5.7 Clearwater Basin Coho Restoration

This coho re-introduction project for the Clearwater Basin in Idaho is being implemented by the Nez Perce Tribe (NPT) and is funded by PCSRF. The NPT is a member of the Mid-Columbia Coho Technical Work Group (TWG). The data and analysis from their M&E plan is shared with this project and others at annual meetings of the TWG.

The Nez Perce Tribe's overall goal is to reintroduce and restore coho salmon to the Clearwater River subbasin at levels of abundance and productivity sufficient to support sustainable runs and annual harvest. Consistent with the Clearwater Subbasin Plan (EcoVista 2003), the Nez Perce Tribe envisions an annual escapement of 14,000 coho to the Clearwater River subbasin.

Uncertainties exist about whether an extirpated salmon species can be reintroduced and restored to healthy abundances 500 miles from the ocean, upstream of eight mainstem hydroelectric dams, using donor stock from the Lower Columbia River. Therefore, like the MCCRP, the NPT decided to develop the reintroduction program in two distinct phases.

- Phase I: Focus on establishing a localized Clearwater River coho salmon broodstock and meeting broodstock needs.
- Phase II: Focus on establishing naturally spawning populations of coho salmon in the Clearwater River Subbasin.

The number of adult coho passing Lower Granite Dam (LGD) has been increasing steadily since 1997 (http://www.cbr.washington.edu/dart/dart.html), suggesting that preliminary reintroduction efforts have successful at stimulating adult returns.

1.5.8 Mid-Columbia HCP Hatchery Compensation Plans

The proposed coho program is consistent with the mid-Columbia Habitat Conservation Plan's Hatchery Compensation Plan (HCP HC) for Rock Island, Rocky Reach and Wells Dams.⁴ The Rock Island HCP HC will provide mitigation for coho salmon "following the development of a continuing coho hatchery program and/or the establishment of a naturally reproducing population of coho" (HCP 2002). Hatchery compensation under the Rocky Reach and Wells Dam HCPs will occur following the development of a continuing coho hatchery program, development of a long-term coho hatchery program, and/or the establishment of a threshold population of naturally reproducing coho in the Methow subbasin.

The Mid-Columbia Coho Reintroduction Feasibility Study (BPA 1996-040-000) has been closely coordinated with ongoing activities of HCP hatchery programs within the Wenatchee and Methow river basins. The proposed coho reintroduction plan will continue to build on this close coordination:

- The current feasibility study and the proposed coho master plan share trapping facilities with HCP steelhead hatchery programs, including trapping at Dryden Dam, Tumwater Dam, and Wells Dam. At each of these facilities, YN personnel and Washington Department of Fish and Wildlife (WDFW) operate the collection facilities together, reducing the personnel trapping needs for both programs.
- YN personnel have helped staff WDFW's smolt trap in the Wenatchee River near Monitor, to collect data during the spring smolt emigration.
- WDFW provides the YN with an annual population estimate for naturally produced coho.
- Hatchery coho are commonly used to evaluate the trap efficiency at the WDFW Monitor smolt trap and the WDFW/Douglas County PUD (DCPUD) smolt trap in the Methow River.
- The YN operates a smolt trap in Nason Creek, designed to collect data from emigrating naturally produced and hatchery produced coho. This trap also collects data on other migrating species that are under the umbrella of CCPUD's HCP monitoring programs and Grant County PUD.
- The proposed monitoring and evaluation plan is coordinated with the CCPUD and DCPUD HCP monitoring and evaluation plans through the sharing of resources and data collection.

1.5.9 Mid-Columbia HCP Tributary Conservation Plans

Under the Rock Island, Rocky Reach, and Wells Dam Habitat Conservation Plans (HCPs) Tributary Conservation Plans (TC), Chelan and Douglas County PUDs will fund habitat improvement projects for the protection and restoration of Plan Species' habitat within the Columbia River watershed, and the Okanogan, Methow, Entiat, and Wenatchee River watersheds. Coho salmon will be considered an HCP Species if criteria described above under *HCP Hatchery Compensation* are met. Habitat improvements in tributaries identified for coho restoration should result in increased productivity for coho salmon and all Plan species.

Mid-Columbia Coho Restoration Program Master Plan

⁴ "Habitat Conservation Plan" is a federal term used in Federal Energy Regulatory Commission (FERC) settlements. Under an HCP, there are several sections: passage survival, habitat and water quality, tributary conservation (tributary fund is here), and hatchery compensation, among other sections.

1.5.10 Grant County PUD Settlement Agreement

Grant County PUD is currently in negotiations with the fisheries management agencies and tribes on finalizing a Settlement Agreement related to fish mitigation that would become a FERC license article associated with the re-licensing of Priest Rapids and Wanapum dams. Coho mitigation language within this Agreement mirrors the HCPs of the other Mid-Columbia PUDs. The draft Agreement states that if a coho hatchery program and/or a naturally reproducing population are established as defined by certain criteria, Grant PUD will provide mitigation to compensate for smolt losses at their two projects, thus providing another funding partner for the coho reintroduction and habitat restoration. This Agreement is in its final phase of negotiation.

1.5.11 Grand Coulee Fish Maintenance Project (GCFMP)

The USFWS operates the Leavenworth National Fish Hatchery Complex (Leavenworth NFH, Entiat NFH, Winthrop NFH). The complex was constructed by the U.S. Bureau of Reclamation (BOR) to replace fish losses that resulted from construction of Grand Coulee Dam. These programs were authorized as part of the Grand Coulee Fish Maintenance Project (GCFMP) on April 3, 1937, and re-authorized by the Mitchell Act (52 Stat. 345) on May 11, 1938. The Leavenworth NFH complex works closely in support of the current coho reintroduction feasibility study (BPA project #1996-040-00). The proposed Master Plan continues to share facilities and resources with all three federal hatcheries that comprise the Leavenworth NFH complex.

1.5.12 Integrated Status and Effectiveness Monitoring Program

The Integrated Status and Effectiveness Monitoring Program (ISEMP, BPA #2003-017-00) is a system-wide, multi-agency effort to implement a subbasin-scale pilot program to monitor status and trends of anadromous salmonids and their habitat in the Wenatchee, John Day, and Upper Salmon River basins; and to monitor the effectiveness of suites of habitat restoration projects in selected watersheds within the three target subbasins. This work builds on current status and trend monitoring programs. Several regional and local organizations are funding and implementing these programs. Much of the work proposed in the M&E plan is closely tied to activities under the ISEMP, including but not limited to smolt population estimates, smolt survival estimates, and species distribution. The ISEMP will continue to provide data to assist in the evaluation of coho reintroduction, and the coho reintroduction M&E project will also contribute to the ISEMP.

1.5.13 Pacific Coastal Salmon Recovery Fund

This fund was established by Congress in FY2000 to provide grants to the States and Tribes to assist state, local, and tribal salmon recovery efforts; it is administered by NOAA Fisheries (NMFS) through Columbia River Inter-Tribal Fish Commission (CRITFC). Projects funded under the PCSRF must be consistent with the Tribes' salmon restoration plan *Wy-Kan-Ush-Mi Wa-Kish-Wit*, and Congressional authorization. PCSRF funds salmon-related habitat restoration and conservation projects; salmon watershed restoration and coordination projects; salmon stock enhancement and supplementation projects; salmon–related research and data collection; and the maintenance and monitoring of projects completed with assistance from this fund, consistent with the overall goal for the PCSRF. Through this program, habitat improvement and protection projects have been funded in the Wenatchee and Methow basins. Past and future PCSRF

projects will help improve and protect coho spawning and rearing habitat. Specific projects in the Wenatchee and Methow basins are as follows:

- Wenatchee Basin Riparian Enhancement This purchase of riparian habitat adjacent to Peshastin Creek will add to habitat protection for coho and other species in this Wenatchee River tributary.
- Nason Creek Wetlands Acquisition This is a YN land purchase that was completed to protect and enhance 26 acres of beaver dam wetlands complex and manage the site to provide for salmon passage to spawning areas and over-winter rearing habitat. These wetlands are located in an important reach of Nason Creek, at RM 7, that provides spawning and rearing habitat for ESA-listed spring chinook and steelhead along with coho and bull trout. The creek has been largely channelized and cut off from the floodplain by the transportation and power transmission corridor. Management of the beaver dams and water levels to provide for adult migration through the property at appropriate times would grant access to underutilized spawning habitat and provide critical over-winter rearing. No beaver dams will be removed. Alternative methods to allow upstream access will be used and could include notches, culverts, fish ladders, or weirs. The site also has potential to provide for acclimation of hatchery coho, steelhead, or spring chinook. The Mid-Columbia Coho Project currently releases smolts in an adjoining pond upstream of this property and may increase the number of coho acclimated and released from Nason Creek with the acquisition of this land.
- *Hancock Springs Restoration* This YN habitat restoration project of a spring-fed tributary of the Methow River will provide off channel rearing for naturalize coho that are part of the re-introduction project.
- Mid-Columbia Project Development Coordinator Employment of 1.0 FTE to focus on project proposal development, funding coordination and implementation for activities in the Upper Columbia (Wenatchee, Entiat, and Methow) region. The basic premise of this Coordinator position is that more successful proposals, benefiting the resource and maintaining a significant and sustained Yakama Nation presence in the Upper Columbia, will be developed if an individual is dedicated to this effort, rather than relying on intermittent and inconsistent efforts. Additionally, thoughtful organization or packaging of proposals will provide for a wider spectrum of funding sources. Allocation of position responsibilities is divided between Wenatchee, Entiat and Methow subbasins with an emphasis on the following priorities:
 - 1. Wenatchee projects associated with the mainstem Channel Migration Zone study; Nason Creek coho acclimation and general salmonid spawning and rearing habitat; and White River habitat acquisition.
 - 2. Entiat In-channel structures and riparian revegetation within the lower mainstem reaches; and habitat enhancements and acquisition in the upper Stillwaters area.
 - 3. Methow Twisp River and Upper Methow coho acclimation sites; Twisp River habitat enhancement, floodplain acquisition, channel re-connection; Beaver Creek steelhead habitat enhancement and potential kelt reconditioning.

1.5.14 Salmon Recovery Funding Board

The goal of the state Salmon Recovery Funding Board (SRFB) is to fund the best salmon habitat projects in Washington State. "Best projects" are those that include local priorities and use the best available science. Eligible projects include restoration, acquisition, and assessment projects that will benefit salmon and the habitat and ecosystem functions on which they depend. Funding for the Board comes from state and federal sources. The SRFB relies on groups in individual watersheds to evaluate and rank proposed projects on an annual basis before it evaluates the proposals and makes funding decisions.

1.6 Decision Process and Schedule

Before this program can be fully implemented, several major steps need to be completed: produce facility designs and specifications; complete Council Step processes; and produce environmental analyses, including those required for NEPA, ESA, and various permitting statutes and regulations. See Chapter 8 for details.

Figure 1-2 shows how the various planning, regulatory, and review processes would fit together.

ELEMENTS	L		006				07				800				09				10	
Tasks	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	ON
NPPC STEP REVIEW																				
Step 1																				
Step 2																				
Step 3																				
PLANNING																				
Coord. Step Process																				
Site Data Collection																				
FACILITY DESIGN																				
Preliminary																				
Wenatchee																				
Methow																				
Final																				
Wenatchee																				
Methow																				
PERMITS																				
Surveys, Studies																				
Cultural Resources																				
Wetlands, Plants	1																			
Flood	1																			
Ground Water																				
Surface Water																				
Listed Species																				
Other Species																				
Discharge Impacts																				
NEPA																				
Scoping, SOW	1																			
Draft EIS	1																			
Public/Agency Input																				
Final EIS, ROD																				
ESA																				
HGMP, BA																				
Public/Agency Input																				
Facility																				
Water Rights	1																			T
JARPA	1																			T
Critical Areas	1																			
Construction	1																			
CONSTRUCTION																				
Real Estate Appraisals																				
Environ. Land Audits	1																			T
Land Purchase	1																			
Wenatchee Con.	1																			
Methow Con.	1																			
	<u> </u>	<u> </u>	<u> </u>		<u> </u>	<u> </u>		<u> </u>		<u> </u>				<u> </u>			<u> </u>	<u> </u>	<u> </u>	

Figure 1-2. Project Schedule

1.7 Master Plan Development Team

The master plan was developed and written by:

- Tom Scribner Yakama Nation, project manager.
- Keely Murdoch Yakama Nation, lead project biologist.
- Cory Kamphaus Yakama Nation, project biologist.
- Scott Prevatte Yakama Nation, project biologist.
- Judy Woodward Crossing Borders Communications, technical writer/editor.
- Greg Ferguson Sea Springs Co, engineer/fish culturist.
- Nancy Weintraub BPA, environmental specialist.

Subcontractors who have been important in the drafting of the plan include:

- Harry Senn Fish Management Consultants, fish culturist.
- Dave Smith C.P. Cramer, salmonid habitat ecologist.
- Jim Miller GeoEngineers, geotechnical engineer.
- Doug Neely International Statistical Training and Technical Institute, statistician.

Members of the Mid-Columbia Technical Work Group have contributed substantially to this master plan, as well as to reviews of the program throughout the years. They include:

- Laurie Weitkamp, Bill Waknitz, Kristine Peterson, Michelle McClure (NOAA Fisheries)
- Jeff Haymes (WDFW)
- Cameron Thomas (USFS)
- David Carie, Julie Collins (USFWS)
- Chris Fisher (Colville Tribe)
- Scott Everett (Nez Perce Tribe)
- Chuck Peven (CCPUD)
- Tom Kahler (DCPUD)
- Linda Hermeston (BPA)

In addition, the team listed below reviewed a draft of the master plan, with significant suggestions for improvements to the proposal.

Name	Affiliation	Area of Expertise
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John McGlenn	TetraTech/KCM, Inc.	Engineering
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Nancy Bond Hemming	Nancy Bond Hemming	Technical Writing
Alison Squier	Ziji Creative Resources Inc.	Writing/editing, Compliance.

CHAPTER 2. EXISTING ENVIRONMENT



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- 2.1 Description of the Subbasins
- 2.2 Status of Coho
 (Oncorhynchus kisutch)
 in the Subbasins
- 2.3 Status of Other
 Anadromous and Resident
 Fish in the Subbasins
- 2.4 Status of Habitat

Chapter 2. Existing Environment

2.1 Description of the Subbasins

The Wenatchee and Methow subbasins are part of the Columbia Cascade Ecological Province, which extends over an area of 14,333 square miles. The province, in north central Washington, encompasses the Columbia River from Wanapum Dam to the limit of anadromous fish passage at Chief Joseph Dam. Tributary subbasins are, for the most part, high-gradient streams that begin in the North Cascade Mountains and drain directly to the Columbia River. The province also includes a few smaller streams that drain smaller watersheds adjacent to the Columbia as well as a number of gulches that arise from the channeled scablands to the east (NPCC 2004a).

Besides the Wenatchee and Methow subbasins, the province includes the Entiat, Lake Chelan, Okanogan, and Upper Middle Mainstem Columbia River subbasins.

Construction of Grand Coulee Dam in 1934 blocked over 1,000 miles of habitat upstream of the Columbia Cascade Province in the upper Columbia River basin. Another 52 miles of habitat was blocked in 1961 by the completion of the Chief Joseph Dam. Six hydroelectric projects are downstream of this ecological province: Wanapum Dam and Priest Rapids Dam, and four federally owned projects—McNary Dam, John Day Dam, The Dalles Dam and Bonneville Dam (NPCC 2004a).

To offset the loss of anadromous salmonid production by the federally built projects, the federal government built and continues to operate the Leavenworth NFH in the Wenatchee subbasin, and later, the Entiat and Winthrop NFHs (ENFH, WNFH) in the Entiat and Methow subbasins, respectively. No federal mitigation facility was constructed in the Okanogan subbasin (NPCC 2004a).

With the construction of each of the privately owned mid-Columbia hydroelectric projects, additional production/hatchery facilities were developed in the Columbia Cascade Province. The recent Habitat Conservation Plan (HCP), initiated by Chelan and Douglas PUDs for ESA Section 10 consultation, identified the mitigation obligation of the PUDs (see Sections 1.5.8 and 1.5.9). The HCP also provides the groundwork for future changes in facility production goals and operations. Details of changes in hatchery production will be resolved over the next several years (NPCC 2004a).

In spite of past mitigation efforts, declining salmonid populations in the Columbia Cascade Province have resulted in ESA listings of spring chinook (Endangered, March 1999) and summer steelhead (Endangered, August 1997). Upper Columbia late-run chinook and Lake Wenatchee sockeye were also petitioned (March 1998) but were determined not warranted for listing. Recent years have shown improved salmonid runs to the province, consistent with findings throughout the Columbia basin (NPCC 2004a).

Native people traditionally lived, hunted, gathered and fished within the Columbia Cascade Province. The province includes land ceded by the Confederated Tribes and Bands of the Yakama Nation (Yakama Nation) under the Treaty of 1855 to the United States. Members of the

Yakama Nation and the Confederated Tribes of the Colville Reservation continue to exercise their hunting, gathering, and fishing rights within the province (NPCC 2004a).

2.1.1 Wenatchee Subbasin

The Wenatchee subbasin lies entirely within Chelan County (Figure 2-1). The subbasin comprises 9.3% of the Columbia Cascade Province and consists of approximately 854,000 acres (1,300 square miles). Approximately 81% of the subbasin is in federal (primarily US Forest Service [USFS]) and state ownership. The remaining 19% of the land is privately owned (NPCC 2004a).

The watershed originates in the Cascade Mountains, and includes the Alpine Lakes and Glacier Peak wilderness areas. The Wenatchee River enters the Columbia River at river mile (RM) 470. Five major tributaries—the Chiwawa, White, and Little Wenatchee rivers, and Nason and Icicle creeks—are the source of over 94% of the surface waters within the subbasin even though their drainage area represents only 58% of the total subbasin area (CCCD 1998 *in* NPCC 2004a).

Four major irrigation districts in the Wenatchee subbasin and two smaller irrigation groups have about 68% of the total issued water rights; other users are domestic (10%), commercial and industrial (8%), municipal (6%), fish hatcheries (3%) and all others (4%). Combined, these users have 420 cfs in water rights permits and certificates (357 cfs surface water, 63cfs ground water). The largest user is the Wenatchee Reclamation District, which serves over 9,000 users by diverting up to 200 cfs at Dryden Dam (NPCC 2004a).

Among subbasins in the upper Columbia region, the Wenatchee supports the greatest diversity of populations and overall abundance of salmonids. There are core populations of sockeye salmon, steelhead, bull trout and both spring and later-run chinook salmon in the upper Wenatchee subbasin that are relatively strong when compared to other populations in the Columbia basin (NPCC 2004a).

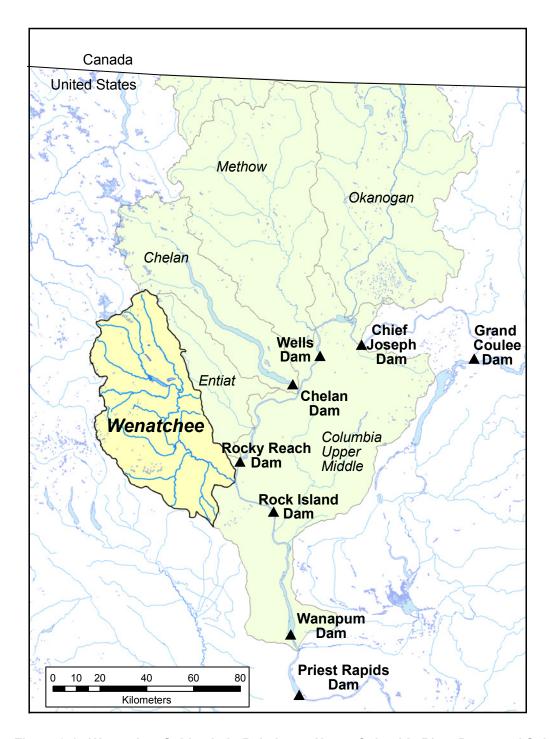


Figure 2-1. Wenatchee Subbasin in Relation to Upper Columbia River Dams and Subbasins

2.1.2 Methow Subbasin

The Methow subbasin lies entirely within Okanogan County (Figure 2-2). The subbasin comprises 12.7% of the Columbia Cascade Province and consists of 1,167,764 acres (1,825 square miles) (NPCC 2004b).

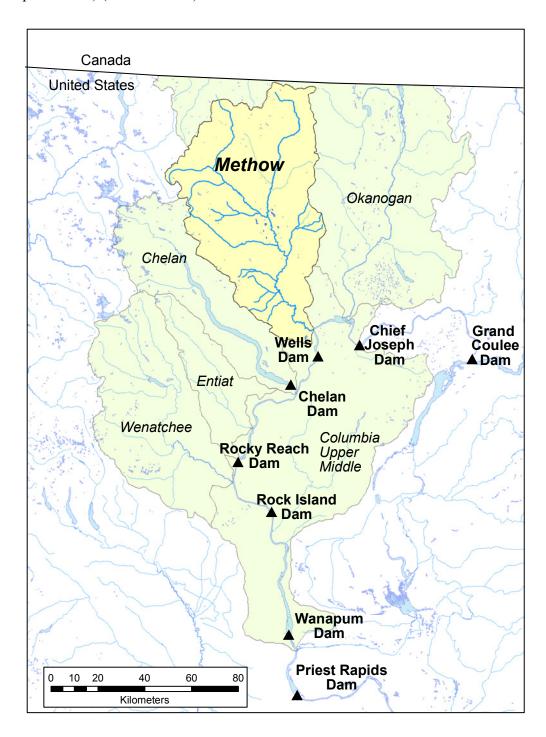


Figure 2-2. Methow Subbasin in Relation to Upper Columbia River Dams and Subbasins

The Methow River's confluence with the Columbia is at river mile 524 near Pateros, Washington. The Methow subbasin is characterized by large tracts of relatively pristine habitat contrasted with a growing human population. Less than 2% of the subbasin's land is irrigated. Six fish species and fourteen wildlife species are listed as Endangered, Threatened, or as Species of Concern (NPCC 2004b).

Logging, mining, orchards, farming, and grazing have played a substantial role in the Methow Valley for nearly a hundred years. Timber operations in the Methow watershed played an important role in the subbasin's economy through the 1800s. Activities related to timber harvest take place in the middle and upper reaches of the watershed (NPCC 2004b).

Unlined irrigation agricultural canals were introduced to the Methow subbasin in the 1800s as ranchers and farmers discovered that an irrigation system was required to supply consistent water for crops and livestock. The height of farming and ranching occurred in the Methow subbasin between 1940 and 1968 when 20,240 acres of land were irrigated from unlined surface diversions. Today, about 17,000 acres are under irrigation, and many of the subbasin farmers raise fresh fruit and vegetables (Methow Basin Watershed Plan, March 2004).

Farming and grazing are confined primarily to the lower and mid reaches of the subbasin. Orchards and small farms growing alfalfa and other irrigated crops constitute the majority of the subbasin's agricultural activities (NPCC 2004b).

Recreation, tourism, and related development play an increasing role in the area's economy. The Methow Valley offers an extensive range of tourism- and recreational-related opportunities (NPCC 2004b).

2.2 Status of Coho (Oncorhynchus kisutch) in the Subbasins

Chapman (1986) estimated that the peak run of coho entering the Columbia River in the 1880s was about 560,000 fish (NPCC 2004b). Mullan (1984) pointed out that most coho spawned in the lower Columbia River tributaries. Mullan (1984) estimated the historical coho run size at 6,000 - 7,000 adults to the Wenatchee basin and 23,000 - 31,000 to the Methow basin. Coho salmon were once considered extirpated in the mid-Columbia region. Recent re-introduction efforts have resulted in natural reproduction occurring in the some parts of the basins.

Population Characterization

Distribution

Historic. Coho salmon were once considered extirpated in the upper Columbia River (Fish and Hanavan 1948; Mullan 1984). Mullan (1984) estimated that upstream of the Yakima River, the Methow River and Spokane River historically produced the most coho, with lesser runs into the Wenatchee and Entiat. There are conflicting reports of whether the Okanogan subbasin historically produced coho (Craig and Suomela 1941; Vedan 2002).

Information regarding the historic distribution of coho salmon within the Wenatchee River basin is limited. Based on affidavits from long-time residents, Nason Creek was likely an important spawning area, and nearly all the smaller creeks had a run of coho salmon (Mullan 1984). The fall run of salmon in the Wenatchee River basin continued until about 1914-1915, after which it rapidly declined (Mullan 1984).

Washington Water Power blocked the Methow River at Pateros between 1915 and 1929 preventing all fish passage during those years and by the time it was removed, the Methow River

run of coho was extinct. By the 1930s, the coho run into the mid- upper Columbia was virtually extirpated. Tributary dams on the Wenatchee, Entiat, and Methow rivers appeared to be more destructive to coho than either steelhead (where genetic "storage" presided in resident forms) or chinook (NPCC 2004b, p. 623).

Because the indigenous stock of coho salmon were extirpated in the upper Columbia River system, the Wenatchee and Methow subbasin coho are not addressed under the ESA or by WDFW's 1994 Washington State Salmonid Stock Inventory (SASSI) (Peven 2003).

Current. Coho salmon rear in their natal tributaries. A portion of juvenile coho migrate downstream during the fall, presumably seeking over-winter habitat (Sandercock 1991). Some juvenile coho may also migrate upstream to over-winter in small tributaries (Tripp and McCart 1983).

Since the YN's program of coho reintroduction feasibility studies began, coho have been found to spawn in the mainstem Wenatchee River (Cashmere to Lake Wenatchee), Nason Creek, Beaver Creek, Icicle Creek, Peshastin Creek, Mission Creek, and possibly Chiwaukum Creek. In 2004, coho also returned to the Little Wenatchee River to spawn. Coho salmon returning to the Methow basin are spawning in the mainstem Methow River and small tributaries such as Gold Creek.

Abundance

Historic. Historically 120,000-166,500 coho were attributed to the mid-and upper Columbia tributaries (Yakima, Wenatchee, Entiat, Methow, and Spokane Rivers) (Mullan 1984). Mullan (1984) estimated that the Wenatchee River supported adult returns of approximately 6,000-7,000 coho and the Methow River supported 23,000 – 31,000.

There were two previous attempts in the twentieth century to rebuild coho populations, although these two programs were not designed or intended to rebuild upriver runs—they were for harvest augmentation. Fish were not released in the natural production habitat areas in the watershed. Between the early 1940s and the mid 1970s, the USFWS raised and released coho as part of their mitigation responsibilities for the construction of Grand Coulee Dam (Mullan 1984). Chelan PUD also had a coho hatchery program until the early 1990s. While some natural production may have occurred from these releases, the programs overall were not designed to reestablish naturally spawning populations. All coho releases under the CCPUD program (1971-1993) were made from the Turtle Rock Fish Hatchery, located in the middle of the Columbia River above Rocky Reach Dam. The release location likely contributed to the inability to produce a naturally spawning coho run. This reach of the Columbia River does not provide suitable coho spawning and rearing habitat.

Current. The Yakama Nation, as the lead agency, has implemented a feasibility study to evaluate coho reintroduction in mid-Columbia tributaries. Since the reintroduction of coho to the Wenatchee River in 1999, the abundance of adult returns has ranged between an estimated 350 to ~4,000 (Murdoch et al. 2004). Many of these fish are taken into the hatchery for broodstock development; the remainder have spawned naturally. The first generation of naturally produced coho smolts emigrated from the Wenatchee River basin in 2002 with an estimated population size of 17,000 (Murdoch et al. 2004). In 2003, approximately 36,700 naturally produced coho smolts emigrated from the Wenatchee River (T. Miller, WDFW, unpublished data).

Since 1999, adult returns to the Methow River have ranged from 140 to 536 (Murdoch et al. 2004). Similar to the Wenatchee, many of the coho returning to the Methow River are either trapped for broodstock at Wells Dam or volunteer into Winthrop NFH. Spawning ground surveys are used to enumerate the numbers and distribution of naturally spawning coho in the Methow Subbasin.

Productivity

Historic. Historic production of coho salmon is difficult to determine, although it was most likely not as high as sockeye or late-run chinook in the Wenatchee (NPCC 2004a). Mullan (1984) estimated the historical coho run size to be 6,000 - 7,000 in the Wenatchee River and 23,000 - 31,000 in the Methow River. Historically, the Methow River produced more coho than chinook or steelhead (Craig and Suomela 1941 *in* NPCC 2004b).

Current. Current productivity is affected by loss or degradation of habitat in spawning and rearing areas, increased downstream mortality through the mainstem Columbia River, ocean conditions, and other abiotic factors (drought, etc.).

As described in the Wenatchee Subbasin Plan (NPCC 2004a), habitats in need of restoration within the Wenatchee basin include Nason, Icicle, Peshastin, Chumstick, and Mission Creeks. These areas lack habitat diversity, may have some passage obstructions, or have poor water quality (NPCC 2004a). Other areas within the Wenatchee subbasin proposed for coho reintroduction have good aquatic habitat and should be protected. The aquatic habitat in the Chiwawa River is in good condition with minimal development (NPCC 2004a). Development is constrained to the lower reach of the Chiwawa River. The White and Little Wenatchee rivers are among the healthiest watersheds in the Columbia Basin (NPCC 2004a).

In the Methow subbasin, habitat losses and associated loss of productivity have chiefly resulted from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, in-stream and floodplain habitat degradation, low flows and dewatering, and extreme water temperatures (NPCC 2004b). By improving habitat in known areas in need of restoration in both subbasins, it is reasonable to assume that production of coho would increase.

Diversity

Because hatchery stocks were used to reintroduce coho salmon (and to develop a local broodstock), spatial and life history diversity within the basin is likely lower than the historic populations of coho salmon. For restoration programs, where the population will be perpetuated from the original founders, collecting a minimum of 50 individuals for broodstock is commonly recommended in the conservation literature to prevent detrimental effects of inbreeding depression. As increased natural production occurs, incorporating naturally produced coho into the broodstock will maintain the effective population size and will encourage genetic diversity (Miller and Kapuscinski 2003). Increased habitat would most likely increase spatial and life history diversity for coho salmon in mid-Columbia tributaries.

Table 2-1. Wenatchee subbasin coho population characterization

	Distribution	Abundance	Productivity	Divsersity
Historic	High	Mod-high	Moderate	High
Current	Low	Low	Low	Low

Historical pictures of the native Methow coho indicate the fish were equal in size to the spring chinook (Mullan et al. 1992b).

Key Life History Strategies: Relationship to Habitat

Time of entry and spawning

Coho salmon enter the Wenatchee and Methow subbasins in early September through late November. Adults ascend the tributaries in the fall and spawn between mid-October and late December, although there is historical evidence of an earlier run of coho salmon (Mullan 1984).

Prespawning

Coho entering in September and October hold in larger pools prior to spawning; entering fish entering later may migrate quickly upstream to suitable spawning locations. The availability and number of deep pools and cover is important to offset potential pre-spawning mortality. Intact riparian habitat will increase the likelihood of instream cover, and normative channel geofluvial processes will increase the occurrence of deeper pools.

Redd characteristics

Clean gravel at the appropriate size and proper water depth and velocity are needed for redd building. Burner (1951) reported the range of depths for coho spawning to be between 8 and 51 cm. Coho spawn in velocities ranging from 0.30 to 0.75 m/s and may seek sites of groundwater seepage (Sandercock 1991).

Incubation and emergence

The length of time required for eggs to incubate in the gravel largely depends on temperature. Sandercock (1991) reported that the total heat requirement for coho incubation in the gravel (spawning to emergence) was 1,036 degree days over zero degrees C (±138 days). The percentage of eggs and alevins that survive to emergence depends on stream and streambed conditions. Fall and winter flooding, low flows, freezing of gravel, and heavy silt loads can significantly reduce survival. In the Wenatchee basin, fall flooding has a high frequency of occurrence. This may negatively affect incubation and emergence success, especially in years of extreme flow. Road building activities in the upper watersheds may also increase siltation, as well as grazing and mining activities. All three factors were once more prevalent than they are now in the basins, and the conditions have improved in most watersheds. Coho fry emerge from the gravel in April or May (K. Murdoch, personal communication).

Fry

Juvenile coho salmon generally distribute themselves downstream shortly after emergence and seek out suitable low gradient tributary and off channel habitats. They congregate in quiet backwaters, side channels, and shady small creeks with overhanging vegetation (Sandercock 1991).

Parr

Coho salmon prefer slower velocity rearing areas than chinook salmon or steelhead (Lister and Genoe 1970; Allee 1981; Taylor 1991a). Recent work completed by the Yakama Nation supports these findings (Murdoch et al. 2004). Juvenile coho tend to over-winter in riverine ponds and other off channel habitats. Over-winter survival is strongly correlated to the quantity of woody debris and habitat complexity (Quinn and Peterson 1996). Conservation of and

restoration of high functioning habitat in natal tributaries along and restoration of riparian and geofluvial processes in or near known and potential parr rearing areas will have the highest likelihood of increasing parr survival.

Smolt

Naturally produced coho smolts in the Wenatchee and Methow subbasins emigrate between March and May (Murdoch et al. 2004).

2.3 Status of Other Anadromous and Resident Fish in the Subbasins

2.3.1 Steelhead

Background

Upper Columbia River tributaries were once productive wild summer steelhead systems, but the populations have declined significantly since the early 1900s. The intensive commercial fisheries in the late 1800s and industrial development of the Columbia River were largely responsible for the decline of the wild steelhead run (Mullan et al. 1992; Chapman et al. 1994b). Unlike chinook and sockeye salmon catches, steelhead harvest remained fairly constant from the early 1900s through 1940 at about 300,000 fish. Between 1938 and 1942, lower river commercial fisheries, including tribal fisheries within Zone 6, took about 70% of the run. Curtailing the commercial fisheries resulted in a resurgence of wild steelhead productivity in the upper Columbia River region, where the run size tripled (5,000 fish to 15,000 fish) between 1941-1954 (Mullan et al. 1992). Sale of steelhead by non-Indians was prohibited beginning in 1975. Subsequent to the dramatic increase, escapement has fluctuated widely. When the wild productivity declined again with completion of the Columbia River hydropower system, hatchery steelhead had replaced natural production in the run counts, masking the gravity of the change in wild fish production. Wild fish were subjected to, and suffered as a result of, mixed stock fisheries in the lower Columbia River directed at their abundant hatchery cohort. And, while the hatchery steelhead could sustain the relatively high harvest rates, their wild counterparts could not.

Hatchery fish made up an increasing fraction of the steelhead run after the 1960s, as wild runs were already depleted (Chapman et al. 1994b). Mullan et al. (1992) spawner-recruit analysis calculated the maximum sustainable yield (MSY) run size and escapement for steelhead at Rock Island Dam to be 16,000 - 19,000 and 4,000 - 7,000, respectively. When hatchery produced steelhead are combined with the naturally produced steelhead, no long-term declining trend is evident. However, naturally produced steelhead currently exist only at threshold levels.

ESA listing status

Upper Columbia River summer steelhead were listed as Endangered in August 1997 because the naturally spawning population was not replacing itself. Hatchery fish in the region, derived from local populations, were included in the listing because they are necessary to achieve recovery.

Current management strategy

Artificial production programs, using locally adapted summer steelhead were fully implemented by the late 1960s. External marking of all hatchery steelhead was implemented in 1987, allowing non-tribal fisheries to increase harvest rates on the component of the run that could

sustain it, while providing more protection to the beleaguered wild component. Current artificial production programs focus releases into the Wenatchee, Methow and Okanogan systems, although the Entiat River received a portion of the hatchery steelhead up through 1998. Since the success of supplementation through artificial propagation remains equivocal, NMFS requested at least one stream in the region be treated as a reference stream, essentially eliminating all hatchery released steelhead. The Entiat River was chosen as the reference stream for the region because of the relatively small number of steelhead released annually (<50,000 fish), the limited public access in comparison to the other rivers, and the greater potential to account for changes in productivity based upon a more refined natural production area in the other systems.

Wild steelhead returning to the upper Columbia River region sustain themselves only at threshold population size today. The high hatchery return rate, genetic homogeneity of hatchery and wild steelhead (Chapman et al. 1994b), and maintenance of near MSY levels in most years suggest a truly wild fish does not exist. Rather, natural production sustains them, and without hatchery supplementation, the steelhead would suffer dire consequences.

All the artificial production programs operating in the region are intended to contribute to recovery of the naturally produced component as well as provide selective harvest opportunities.

Escapement objectives

The run size needed at Priest Rapids Dam to meet minimum escapement objectives for the tributary streams of the region totals 9,550 adults. The 9,550 fish run size is intended to provide a minimum of 2,500 natural spawners in the Wenatchee River, 2,500 natural spawners for the Methow River, and 600 natural spawners for the Okanogan River. Although the total run size is managed as a composite of hatchery and wild fish, because conservation and recovery of the Evolutionarily Significant Unit (ESU) is critical, embedded within the total run size is the requirement to achieve at least 1,300 wild (naturally produced) summer steelhead.

2.3.2 Spring Chinook

Background

The numbers of spring chinook that entered the Columbia River in the years immediately following the construction of Bonneville Dam (1938) averaged less than 102,000 (Chapman et al. 1995a). Numbers of spring chinook passing Rock Island Dam in the late 1930s and 1940s were likely depressed from years of over fishing. Runs increased in the 1950s, partly in response to reduced harvest rates. However, reduced harvest rates occurred concomitant with the hydropower development era, essentially reducing production of spring chinook from the upper Columbia. Spring chinook counting at Rock Island Dam (1933) began in 1935, and the numbers for the period 1935 – 1938 were less than 3,000 fish per year. Adult counts of spring chinook passing dams upstream of Priest Rapids Dam fluctuated extensively in the years following, but reached a peak of about 27,000 fish in the mid-1980s, a period of high ocean productivity. Escapements dropped precipitously in the six years following the peak, rose again in 1992 and 1993, but dropped to less than a few hundred in 1995 when ocean productivity dropped.

PUD-funded programs began comprehensive operation in the late 1980s and early 1990s. The focus of these programs was to increase the number of adult spring chinook spawning naturally by using locally adapted spring chinook, i.e., supplementation.

ESA listing status

Spring chinook from the upper Columbia River region was listed as Endangered under the ESA in March 1999. Three populations of spring chinook are recognized within the ESA listing; Methow, Entiat and Wenatchee. All three have established recovery levels, and collectively will need to meet or exceed these levels for the ESU to achieve recovery. In addition to the ESA listing of the natural origin spring chinook, hatchery origin spring chinook derived from local populations were included within the listing since they were deemed necessary to achieve recovery. Carson NFH-origin spring chinook continue to be reared at the Leavenworth and Entiat federal facilities. These fish are not included in the listing, and are therefore not subject to ESA management constraints.

Current management strategy

The WDFW operates several hatcheries and/or their satellite facilities above Priest Rapids Dam to produce spring chinook smolts for release into the Chiwawa, Chewuch, Methow and Twisp rivers. Commensurate with hydropower dam relicense requirements through the Federal Energy Regulatory Commission (FERC), the Wenatchee basin spring chinook smolt release number total is expected to increase, as well as expand to other tributaries, namely Nason Creek and the White River.

Current programs, as well as anticipated programs, reflect the origin of adults used for brood fish to produce the subsequent progeny. A supplementation strategy, using wild fish in the broodstock, is used with the goal of increasing the number of adults successful at spawning naturally.

Escapement objective

Spring chinook natural spawning escapement objectives for the principle tributaries to the upper Columbia River region include about 4,100 for the Wenatchee, 500 for the Entiat, and 2,000 for the Methow. These numbers are also consistent with carrying capacity or recovery requirements. In addition to the natural spawning escapement, artificial production requirements total almost 2,600 adults, including the federal facilities. Minimum run size necessary at Priest Rapids Dam to achieve the 9,200 fish natural escapement and brood stock goals is 16,000 spring chinook.

2.3.3 Upper Columbia Sockeye

Background

Sockeye in the Columbia River upstream from the confluence of the Snake River historically inhabited the lakes of the Yakima basin, Lake Wenatchee, lakes upstream and including Lake Osoyoos in the Okanogan basin, and the Arrow Lakes in British Columbia (headwaters to Columbia River). Construction of impassable dams, removal of water for irrigation, hydropower operations, and overfishing significantly altered the historic distribution of sockeye upstream of the Snake River, such that Lake Wenatchee and Lake Osoyoos retain the only current populations.

Since 1938, the percentage of sockeye destined for waters upstream of Rock Island Dam has been reported to vary from less than 1% (1941) to greater than 95% (1979) of the total that entered the Columbia River (Chapman et al. 1995b). Although in some years the escapement has been significantly altered by harvest in the lower Columbia River, i.e., in the mid-1980s, the percentage as a total of the run to the mouth of the Columbia River has grown steadily to

generally exceed 90%. The percentage of adults returning to Lake Wenatchee and Lake Osoyoos has varied considerably from the total at Rock Island Dam. Historically, the Lake Wenatchee population outnumbered the Lake Osoyoos population. However, since the early 1960s and with the exception of 2002, the percentage of sockeye destined for Lake Osoyoos has been greater than the percentage destined for Lake Wenatchee. More recent counts have shown the Lake Osoyoos population to generally represent 60 - 75% of the count at Rock Island Dam. However, the percentage of adults observed on the spawning grounds has not comported well with the number of fish counted at different dams. Spawning ground surveys in both basins have often been able to account for only 50 - 70% of the dam counts. A variety of reasons could contribute to this disparity, including: 1) inflated dam counts due to a high rate of fallback, 2) inefficiencies of the spawning ground surveys as they relate to the ability to accurately account for total escapement, and 3) high pre-spawning mortality (conceivably a factor for the Lake Osoyoos population).

Historical artificial production programs were supported by the USFWS, but sockeye were not a dominant species cultured; by the 1960s, no artificial production of sockeye was occurring within the region. In 1990, the WDFW began operation of a small artificial production program (200,000 smolts) for sockeye from Lake Wenatchee as part of the Rock Island Settlement Agreement and now the new Mid-Columbia River Habitat Conservation Plan (HCP).

ESA listing status

Upper Columbia River sockeye are not currently listed under the federal ESA. The stock status for the Wenatchee population was rated as depressed by WDFW in 2002 because of short-term severe declines escapements in 1998 and 1999. The spawning escapement goal for this stock is 23,000 fish. Despite a significant improvement in the 2000 and 2001 returns, the stock has been at less than half the goal from 1994 to 1999.

Management strategy and escapement objectives

The natural and hatchery populations of sockeye originating from the Wenatchee and Okanogan basins are managed for natural spawning escapement goals of 23,000 fish over Tumwater Dam in the Wenatchee basin.

Recreational fisheries will be implemented when the run size exceeds (or is expected to exceed) 25,000 sockeye at Tumwater Dam. The Lake Wenatchee population is the only one that has an artificial production program associated with it. The current artificial production program of 200,000 smolts annually is support by CCPUD as part of the Mid-Columbia River HCP (formerly part of the Rock Island Settlement Agreement). This program is slated to change, and likely increase, consistent with the recently signed Mid-Columbia River HCP, which replaces the Rock Island Settlement Agreement.

2.3.4 Upper Columbia Summer/Fall Chinook

Summer/fall chinook are not considered NTTOC as it relates to coho restoration. The Upper Columbia River summer chinook aggregate population is healthy and not ESA listed. The population(s) was proposed for listing in the early 1990s, but a final determination by NOAA Fisheries concluded a listing was not warranted. Total spawner abundance has continued to increase from the low levels experienced in the early 1990s to the currently strong returns.

2.3.5 Bull Trout

Background

Bull trout (*Salvelinus confluentus*) are members of the char subgroup of the family Salmonidae. Bull trout range throughout the Columbia River and Snake River basins, extending east to headwater streams in Montana and Idaho, into Canada and in the Klamath River basin of south-central Oregon. Distribution of the population is scattered and patchy (USFWS 2005). Bull trout exhibit a number of life-history strategies. Stream resident bull trout complete their entire life cycle in the tributary streams where they spawn and rear. Most bull trout are migratory, spawning in tributary streams were juvenile fish typically rear for one to four years prior to migrating to either a larger river (fluvial) or lake (adfluvial), where they spend their adult life, returning to the tributary stream to spawn (Fraley and Shepard 1989).

For the purposes of recovery, the Upper Columbia Recovery Unit Team has identified three core areas, including the Wenatchee, Entiat, and Methow rivers. Within each core area many local populations may exist.

Within the Wenatchee Core Area, bull trout are dispersed throughout the basin with the strongest populations centered around Lake Wenatchee and the Chiwawa River (WDFW 1998). The Draft Recovery Plan (Chapter 22 - Upper Columbia Recovery Unit) identifies 6 migratory local populations within the Wenatchee River; these local populations include the Chiwawa River (including tributaries), White River, Little Wenatchee River (below the falls), Nason Creek (including Mill Creek), Chiwakum Creek and Peshastin Creek (including Ingalls Creek). Resident, fluvial, and adfluvial bull trout currently exist in the Wenatchee River Core Area (WDFW 1998). Resident bull trout occur in Icicle Creek above the barrier falls, and migratory bull trout are known to frequent the area below the falls. The Chiwawa River local population complex is the stronghold for bull trout in the upper Wenatchee (WDFW 1998). Adult bull trout 46 to 61 centimeters in length have been found throughout the river. Whether these migratory fish are fluvial (from the mainstem Chiwawa River, Wenatchee River, or Columbia River), adfluvial fish from Lake Wenatchee, or a combination is not known.

Within the Methow Core Area bull trout are known to occur in Gold Creek, Twisp River, Chewuch River, Wolf Creek, Early Winters Creek, Upper Methow River, Lost River, and Goat Creek. The WDFW classifies the status of bull trout in the Lost River as "healthy" but the remaining bull trout in the Methow River are classified as "unknown" (WDFW 1998). Within the Methow River adfluvial, fluvial and resident life history forms are present. The largest populations of migratory bull trout occur in the Twisp River, Wolf Creek, West Fork Methow River, and Lost River. The overall status and distribution of resident bull trout with in the Methow River is unknown (Draft Bull Trout Recovery Plan).

Overall, bull trout in the Wenatchee, Entiat, and Methow core areas persist at low abundance with the population in the Chiwawa River. Since 1999, estimates of spawning adults in the Chiwawa River have ranged between 246 and 462 (from the Draft Bull Trout Recovery Plan). Results from the 2001 redd surveys in the Wenatchee Core Area indicate that the annual spawning population is probably less than 1000 individuals and should be considered at risk of genetic drift. Seven of the local population in the Methow Core Area are mostly under 100 adults annually and are at risk of inbreeding depression. Based on available information, adult spawning abundance in the Methow Core Area is probably less than 1000 adults.

Reasons for decline of bull trout include historic and current land use actives. Some of the activities, especially water diversions, hydro power development, forestry and agriculture within core areas may have significantly reduced important fluvial populations (Draft Recovery Plan).

Declines in salmon species (including the extirpation of coho salmon) have decreased the forage base for bull trout. In addition to decreasing prey availability, the decline of salmon and steelhead reduced a historic energy source coming into the basin through the dying and recycling of nutrients from adult carcasses, eggs and juveniles.

ESA listing status

The USFWS issued a final rule listing the Columbia River and Klamath River populations of bull trout as a threatened species under the ESA on June 10, 1998 (63 FR 31647). The Upper Columbia Recovery Unit encompasses the geographic area from the Yakima River upstream to Chief Joseph Dam. The recovery unit includes the Enitat, Wenatchee, Methow, Chelan, and Okanogan basins, and the mainstem Columbia River.

Although proposed as Critical Habitat, the final rule, published on September 26, 2005 (USFWS 2005), excluded the all proposed critical habitat in the upper Columbia subbasin, including the Wenatchee and Methow rivers.

Current management strategy

The goal of the bull trout recovery plan is to ensure the long-term persistence and self-sustaining, complex, interacting populations of bull trout distributed across the native range of the species so that they can be delisted. To achieve this goal, the following objectives have been identified for bull trout in the Upper Columbia Recovery Unit (from the Draft Recovery Plan): 1) maintain the current distribution of bull trout and restore distribution in previously occupied areas within the Upper Columbia Recovery Unit, 2) maintain increasing trends in abundance of bull trout, 3) restore and maintain suitable habitat conditions for all bull trout life history stages and strategies, and 4) conserve genetic diversity and provide opportunities for genetic exchange.

Recovered abundance levels in the Upper Columbia Recovery Unit were determined by considering theoretical estimates of effective population size, historical census information and professional judgment of the recovery team.

Recovery criteria for bull trout in the upper Columbia Recovery Unit are as follows:

- 1) Distribution criteria will be met when bull trout are distributed among at least 16 local populations in the Upper Columbia Recovery Unit.
- 2) Abundance criteria will be met when the estimated abundance of adult bull trout among all local populations in the Upper Columbia Recovery Unit is between 6,322 to 10,426 fish.
- 3) Trend criteria will be met when adult bull trout exhibit a stable or increasing trend for at least two generations at or above the recovered abundance levels within the Wenatchee, Entiat and Methow core areas.
- 4) Connectivity criteria will be met when specific barriers to bull tout migration in the Upper Columbia Recovery Unit have been addressed.

2.4 Status of Habitat

Habitat in these basins has been evaluated and described using several methods. Section 2.4.1 summarizes habitat descriptions from the Wenatchee and Methow subbasin plans. Using these descriptions, Section 2.4.2 evaluates habitat using the NPCC habitat condition criteria (NPCC 2000). Section 2.4.3 presents the EDT analysis of the Wenatchee and Methow subbasins.

2.4.1 Habitat Descriptions from Subbasin Plans

2.4.1.1 Wenatchee Subbasin Habitat Description

The Wenatchee subbasin contains some of the most pristine habitat in the Columbia River Basin (NPCC 2004), while also experiencing considerable habitat degradation in some drainages. The subbasin is very diverse in elevation and environmental conditions. Quality Habitat Assessment (QHA) was used during the subbasin planning process to provide a structured qualitative approach to analyzing the relationship between the focal species and habitat conditions. For the assessment, the Wenatchee subbasin was divided into 11 Assessment Units that included the lower (mouth to Tumwater Canyon) and middle Wenatchee River (Tumwater Canyon to Lake Wenatchee) and tributaries: Mission Creek, Peshastin Creek, Chumstick Creek, Icicle Creek, Nason Creek, Chiwawa River, White River, Little Wenatchee River and Lake Wenatchee. The status of the habitat described below was summarized from the Wenatchee Subbasin Plan (NPCC 2004a).

Lower Wenatchee River

The lower portion of the Wenatchee River begins at RM 25.6 (below Tumwater Canyon) and flows southeasterly from the town of Leavenworth to the Columbia River. Settlement along the Wenatchee River began in 1890 with the construction of the Great Northern Railroad along the Wenatchee River. This was followed by floodplain development, irrigation diversion structures and bank armoring. Over a century of development has reduced in-stream large woody debris (LWD) and LWD recruitment, and reduced side channel/wetland habitat as well as the opportunity for development of side channel/wetland habitat. To varying degrees the altered riparian and channel conditions have also reduced pool frequency, increased bank erosion, possibly increased channel entrenchment and altered stream flows. Stream diversions and well withdrawal from shallow aquifers in the floodplain probably have the greatest influence on low stream flows. Channel confinement, channelization, and riparian and upland land use impacts probably have the greatest influence on peak flow timing and duration.

Middle Wenatchee Assessment Unit

The middle Wenatchee assessment unit includes the mainstem Wenatchee River from Tumwater Canyon (RM 25.6) to Lake Wenatchee (RM 54). Within Tumwater Canyon, the river character has been modified over time by railroad construction, dam construction, log drives, and highway construction. During railroad construction in the 1800s, the canyon bottom was narrowed and large boulders were removed, possibly resulting in channel degradation (Andonaegui 2001). Tumwater Dam at RM 31, built in the early 1900s, has altered channel bed grade and substrate content above and below the structure, creating Lake Jolanda. Log drives in the early 20th century removed LWD in the channel and blasted boulders from the channel to facilitate log drives. Within the Wenatchee River upstream of Tumwater Canyon, channel complexity and riparian condition has been altered over time from historic log drives and floodplain and streamside development. Results of these activities include reduced riparian and wetland

connectivity, a loss of aquatic species connectivity through wetlands, reduced high flow refuge, reduced sinuosity and side channel development, increased bank erosion, reduced single pieces and complexes of LWD, reduced pool frequency, and a reduction in channel roughness. Anthropogenic factors affecting the upper Wenatchee subbasin include private home building and associated private land development; timber harvest on both private and federally owned lands, faming and associated land conversion, and the construction of state highways, county roads and logging roads.

Mission Creek

Mission Creek drains a 59,712 acre watershed located approximately 10 miles west of Wenatchee. Mission Creek flows 9.4 miles before emptying into the Wenatchee River (RM 10.4) at the town of Cashmere. Mission Creek is considered the most polluted water body in the Wenatchee River subbasin. Cumulative disruption of both stream channel and upland habitat throughout the watershed, except in the Devils Gulch reach of Mission Creek, has resulted in a declining population of salmonids since the mid 1880s (Rife 1999). Conditions that limit rearing habitat in the watershed include dewatering, low flows, and high in-stream temperatures (Andonaegui 2001). Diversion dams and culverts also create fish passage barriers that reduce access to spawning and rearing habitat. Floodplains have been separated from the stream channels and channels have been altered by forest roads, urban, agricultural and residential development. Channelized streams have eliminated or reduced woody riparian vegetation to a narrow band of mostly shrubs with some mature trees. Water quality in Mission Creek is poor. Mission Creek is on the WDOE 1998 303(d) list for temperature, low dissolved oxygen, high fecal coliform and pesticide counts. Water quantity in Mission Creek is also poor; the watershed is on the 303(d) list for low in-stream flows.

Peshastin Creek

Peshastin Creek originates near Swauk Pass and flows north, entering the Wenatchee River downstream of the town of Peshastin at RM 20. Ingalls Creek is the largest tributary to Peshastin Creek. The loss of channel sinuosity, floodplain function and riparian habitat (including off channel habitat) within the channel migration zone of Peshastin Creek has had the greatest effect on salmon production. Channel confinement resulting from the improvement of State Route 97 has reduced spawning habitat for salmon and steelhead and has also reduced juvenile rearing habitat for all salmonid species, especially over-wintering habitat. Floodplain and riparian habitat function have been reduced by residential and agricultural development, timber harvest and mining activity that has been active in various forms for over 100 years. Low LWD counts further reduce habitat quality. Peshastin Creek has been added to the current 303(d) list for exceeding temperature requirements and is considered "poor" by Forest Plan standards. Peshastin Creek is also included on the WDOE 1998 303(d) list for low in-stream flows.

Chumstick Creek

The Chumstick watershed is oriented in a north-south direction, with tributaries entering from the north and east. Chumstick Creek flows south into the Wenatchee River at RM 23.5, at the east end of the town of Leavenworth. Chumstick Creek once supported a population of summer steelhead, coho and possibly spring chinook salmon. Land development and use on both public and private land have created poor habitat conditions for most stream attributes. Railroad logging began in Chumstick valley in 1910 when the Lamb-Davis Timer company finished laying 26 miles of track from Leavenworth to Plain. In later years the track was removed and

used as the base for Highway 207. Many degraded habitat attributes can be linked to channel confinement resulting from road density and construction, loss of floodplain connectivity and alteration of disturbance regimens. Additionally, in-stream flows are very low, upstream access is blocked by multiple stream crossing and impoundments, water quality is degraded, and high-fine sediments may limit spawning success and food production by macro-invertebrate communities. The Chumstick Creek drainage has bee identified as one of the more problematic watersheds in the Wenatchee subbasin relative to land-use impact and management issues. Even if fish passage is restored, degraded habitat quality and low flow conditions will continue to limit salmon production. Chumstick Creek is on the WDOE 303(d) list for dissolve oxygen, fecal coliform, pH, and low in-stream flow.

Icicle Creek

Icicle Creek originates high in the Cascade Mountains and is a 5th order stream. Icicle Creek drains a 214 square miles in North Central Washington. Icicle Creek flows east 31.8 RM before emptying into the Wenatchee River at RM 25.6 in the city of Leavenworth. From the USFS wilderness boundary to the headwaters, aquatic habitat closely resembles historic conditions. Floodplain connectivity and riparian habitat below the wilderness boundary have been altered through the construction of roads, campground development, timber harvests and private development. Habitat alteration increase dramatically below RM 2.8, primarily from streamside development and channel confinement. Bank stabilization, flood control, and loss of riparian habitat limits the streams ability to adjust to sediment, debris and high flows. This loss of function exacerbates bank destabilization in a naturally mobile stream section which in turn contributes additional sediment to the stream channel. Decreased in-channel complexity from the loss of LWD degrades channel conditions in the lower 2.8 miles (Andonaegui 2001). Leavenworth National Fish Hatchery (LNFH) structures block anadromous migration beginning at RM 2.8. The LNFH intake diversion dam is a fish passage barrier at low flows. The Icicle-Peshastin Irrigation District diversion dam at RM 5.7 may also hinder upstream fish passage at low flows (Mullan et al. 1992). Fish screens at the District and LNFH diversion do not meet current NMFS criteria and require updating. Changes in the historic channel's flow regime have caused sediment accumulation and vegetation encroachment. As a result, the historic stream channel has evolved from riverine to wetland. These issues are currently being addressed and are slated for construction in 2006. Once completed, the LNFH and the irrigation withdrawal will be in compliance with NOAA Fisheries and USFWS requirements under Section 7 of the ESA.

Nason Creek

The headwaters of Nason Creek lie in the eastern slopes of the Cascade Mountains. Nason Creek flows east out of Lake Valhalla (4,830 feet elevation) for approximately 21 miles and empties into the Wenatchee River at RM 53.6 just below Lake Wenatchee. Habitat in Nason Creek has been altered by human activities including railroad development, road building, channel straightening, timber harvest, and private development; the lower 15 miles of Nason Creek contain the most habitat features in poor condition. Due to a natural fish barrier, Gaynor Falls, this reach also contains all the anadromous salmonid spawning habitat and is a key corridor for connectivity of sub-watersheds. Low in-stream flows are common in August and September, a natural condition related to snow accumulation and snow melt patterns (Andonaegui 2001).

Little Wenatchee River

The Little Wenatchee River is a 4th order stream draining a 64,794-acre watershed. The Little Wenatchee River flows southwest for 25 miles and empties into Lake Wenatchee. The Little Wenatchee River is among the healthiest watersheds in the Columbia basin (NPCC 2004). Several moderate habitat concerns exist, however. Most of the concerns occur in and below areas of extensive timber harvest (Andonaegui 2001; USFS 1998). Most timber harvest in the Little Wenatchee River corridor has occurred from the mouth upstream to Cady Creek (RM 0.0-16.9) and in the Rainy Creek drainage. In these areas, the potential for LWD input has decreased. Moderate road densities of 2.4 mi/sq mile and harvest activities may also contribute to high stream temperatures by increasing runoff and decreasing water storage potential (Andonaegui 2001). During the 1970s, biologist were concerned that LWD complexes created fish passage barriers in the lower few miles of the river. They made several attempts to remove the complexes, although wood kept accumulating in the same locations (Andonaegui 2001; Mullan et al 1992; USFS 1998). A stream survey conducted in 2000 concluded that LWD levels below RM7.8 had good quantities of LWD present in the channel (Andonaeaui 2001). Pool frequency, depth and quality is considered good (Andonaegui 2001).

White River

The White River is a 5th order stream. The drainage encompasses 99,956 acres and originates in alpine glaciers and perennial snow fields. The White River flows south-southeast for the majority of its length (26.7 RM). Two large tributaries, Napeequa (RM 11.0) and Panther (RM 13.1) creeks, support anadromous salmonids. The White River drainage is among the healthiest in the Columbia basin (NPCC 2004). Several habitat concerns, however, exist (USFS 1998; Andonaegui 2001). The mainstem below the wilderness boundary has had some alteration; consequently, many habitat indicators are in only fair condition. The most altered are in the lower watershed below Panther Creek. Changes have resulted from floodplain development and impacts on riparian areas from historic cedar logging and roading. On private lands development of homes and vacation retreats is occurring (USFS 2004). The mainstem below White River Falls is a key spawning and migration corridor for anadromous salmon. The White River still maintains high quality, complex habitat with refuge and rearing habitat for multiple life stages and life histories. The watershed is well connected to adjacent high quality habitat in Lake Wenatchee and the Chiwawa River that provide refuge during disturbance events. The floodplain is in good condition.

Chiwawa River

The Chiwawa River originates from 5 glaciers on the southwestern slopes of the Entiat Mountains and flows southeasterly for 37 miles to its confluence with the Wenatchee River near the town of Plain. The Chiwawa River is a 5th order stream. Overall the Chiwawa watershed is in good condition. Development is minimal compared to most other watersheds in the Wenatchee subbasin and is constrained to the lower areas of the watershed. The lower Chiwawa River has several activities that can potentially influence watershed conditions, including high road density, road location, private land development, forest practices, and a water diversion. Road concerns occur mainly in the lower mainstem and Meadow Creek. In the upper watershed, there is no indication that frequency, size or intensity of natural disturbance events has changed other than alteration of the fire cycle through fire suppression. Channel conditions for much of the upper Chiwawa are presumed to be near historic conditions since floodplain connectivity

remains intact and channel condition has had only minor alteration. In the lower Chiwawa River, log drives occurred until the mid-1930s. Although channel conditions have repaired considerably since that time, some evidence of in-channel degradation remains. Chiwawa wetlands and off-channel habitat in the watershed are in good condition (USFS 2003). The valley floor has an extensive network of ponds, beaver canals, side channels, abandoned oxbows and other wetlands. Abundance diversity, connectivity and quality of these wetlands is high.

2.4.1.2 Methow Subbasin Habitat Description

The Methow River basin is comprised mostly of large tracts of relatively pristine habitat. Topography varies from mountainous alpine terrain at elevations of 8,500 feet to gently sloping wide valleys down to an elevation of 800 feet. This diverse habitat supports well over 300 species of fish and wildlife (NPCC 2004b). The Methow Subbasin Plan (NPCC 2004b) reports that Methow basin habitat losses have resulted chiefly from artificial and natural fish passage barriers, alteration and reduction of riparian habitat, loss of habitat connectivity, in-stream and floodplain habitat degradation, low flows, and dewatering.

Lower Methow River

The lower Methow River includes the Methow mainstem and its tributaries from the town of Carlton to the mouth of the Methow River. Agriculture uses in this sub-watershed are primarily field crops and cattle at the upper end, with orchards along the lower end. This reach provides rearing habitat and acts as a migration corridor for all anadromous salmonids. Timber harvest, livestock grazing and high road densities characterize much of the Libby Creek drainage, with roads running parallel to every major stream. The lower 2.9 miles of Libby Creek has been channelized. Culverts and irrigation diversion structures impede salmonid passage on a number of tributaries. Upstream passage for salmonids is also limited by heavy beaver activity in some tributaries. Timber harvest, livestock grazing and elevated road densities also characterize Gold Creek. The lower 3.5 miles of Gold Creek have had riprap placed along the banks. Gold and Libby Creeks are characterized by low in-stream flows, and Gold Creek dewaters in a lower reach between RM 3 and RM 2 during some low-water years.

Middle Methow River

The middle Methow drainage includes the mainstem Methow from its confluence with the Chewuch River to the town of Carlton. County roads and state highways parallel both sides of the Methow River throughout this reach. Diking, conversion of riparian area to agriculture and residential uses and LWD removal along the mainstem Methow River have resulted in loss of side channel access, riparian vegetation, and overall habitat complexity. Much of the habitat within this area has not been adequately inventoried or assessed, and data gaps exist regarding the extent of habitat alterations. The Methow Valley Irrigation District diverts water to its east canal, about five miles north of the town of Twisp at RM 44.8.

Upper Methow River

The upper Methow River drainage includes the mainstem Methow from its headwaters to the Chewuch River (RM 50.1). Major tributaries in the drainage include Goat Creek, Wolf Creek, Hancock Creek, Little Boulder Creek, Dawn Creek, Gate Creek, Robinson Creek, Rattlesnake Creek and Trout Creek. Methow mainstem habitat between the Lost River confluence and Winthrop has been greatly affected by human activity. The river has a low gradient throughout this reach, and a number of dikes block assess to valuable side-channel spawning and rearing

habitat. The floodplain is constrained by those dikes as well as by rip-rapping and bank stabilization measures. Riparian habitat has been converted to agricultural use, and more recently and increasingly, to residential use along the mainstem between the Early Winters confluence and the Mazama bridge, which in some areas has resulted in bank erosion. Historic timber harvest activities, fire, livestock grazing, and construction of logging roads throughout the lower reaches of the Goat Creek and Wolf Creek drainages have also resulted in large sediment loads in the Methow River. Improvement in grazing practices in this sub-watershed and in other areas of the basin has helped reduce the current impact of livestock grazing. The amount of sediment delivered to creeks and streams from natural occurrences has not been quantified relative to the amount of sediment contributed through human use.

Twisp River

The Twisp River flows into the Methow at the town of Twisp. A substantial portion of the Twisp river sub-watershed lies within designated wilderness and is in nearly pristine condition. Most human activity and related habitat changes within the drainage have taken place in the lower 15 miles of the Twisp River. Reduced levels of LWD, road placement, diking, bank hardening, and conversion of riparian areas to agriculture and residential uses have altered habitat conditions in this area, resulting in the loss of channel complexity and floodplain function. There are seven irrigation diversions on the Twisp River. The Twisp River from Buttermilk Creek to the mouth has been diked and rip-rapped in places, resulting in a highly simplified channel and disconnected side channels and associated wetlands. Levels of LWD recruitment potential in the lower Twisp River are below normal.

Beaver Creek

Beaver Creek drains into the Methow River five miles downstream from the town of Twisp. Previously, anadromous salmonids have had limited access to Beaver Creed due to its many obstructions. Most of these diversions have been removed or are in the process of being modified for passage. Road density in the Beaver Creek drainage is the highest in the Methow subbasin. Extensive timber harvest has occurred in the Beaver Creek drainage since the 1960s, resulting in heavy sediment loading, slop destabilization, and reduction in recruitment potential for LWD (USFS 2000a). Limited grazing activity has also contributed to stream sediment delivery in this Beaver Creek. In low-water years, Beaver Creek goes dry in the fall, except in the uppermost reaches and in the lowest 0.3 mile, which maintain flows via irrigation return.

Chewuch River

The Chewuch River enters the Methow at the town of Winthrop. The majority of the human impact has occurred in the lower half of the drainage, with the upper 50% remaining generally undisturbed. Five ditches divert water within the Chewuch sub-watershed, and two roads parallel segments of the Chewuch. Low flows in late summer through winter reduce quantity of rearing habitat in the lower Chewuch River. High water temperatures in the lower river may at times cause a migration barrier. Extensive riprap for flood control associated with residential development has also occurred in the lower eight miles of the Chewuch as well as along several tributaries. The drainage's upper reaches are characterized by harsh winters and icing.

Early Winters Creek

Early Winters Creek enters the Methow about 3.5 miles upstream from the town of Mazama. The majority of the watershed is in relatively pristine condition. Human impacts are primarily

restricted to the lower two miles of Early Winters Creek, including its alluvial fan. The lower half-mile has been rip-rapped and diked to keep the channel in a stable location in order to accommodate Highway 20 and to protect private property. Levels of LWD in the first two miles are low, and pool quality and quantity is poor. Severe low flows persist in the lower 1.4 miles of the creek. Low base flows are naturally occurring during the winter months; however, low flows during the late summer and early fall may be exacerbated by two irrigation diversion (USFS 1998b). In 2000 and 2001 the USFS completed a restoration project on this reach of the creek. The restoration included an increase of LWD, pools and quality habitat. The Early Winters Ditch on Early Winters Creek is currently meeting NMFS and USFWS target flow of 35 cfs for spring chinook and bull trout, and the irrigation district is using wells that are not in continuity with groundwater and surface water to meet the remainder of its irrigation needs. Fine sediment and chemical runoff from state Route 20 may negatively affect water quality.

Wolf Creek

Wolf Creek, a Methow River tributary, drains the Methow about 3 miles above the town of Winthrop. Approximately 80% of the drainage is designated wilderness with very good habitat conditions. The Forest Service manages the remainder of the drainage for multiple uses with exception of the last 1.5 miles, which is privately owned. Impacts from timber harvest and roads are limited primarily to the Little Wolf Creek drainage. Introduction of woody debris and pool formation projects were completed in 2000 along the lower 0.5 mile of the creek.

Goat Creek

Goat Creek drains into the Methow from the north about a mile downstream from the town of Mazama. Portions of the upper third of the Goat Creek drainage have been heavily grazed. The lower two-thirds of the drainage have been logged, roaded and grazed (USFS 1995). The Goat Creek drainage has over 150 miles of roads—more than 4 miles of road per square mile—with almost all of those located in the lower half of the drainage. Sediment from roads and slope failures is carried by Goat Creek to salmon spawning areas in the Methow River. Livestock have also damaged or suppressed re-growth of riparian vegetation in some tributaries. Goat Creek exhibits elevated water temperatures, low flows, and/or dewatering in August and September (USFWS 1998).

Lost River

The Lost River empties into the Methow River from the north at RM 73.0, roughly six miles above Early Winters confluence. About 95% of the drainage lies within the Pasayten Wilderness. Human impact in the drainage is largely restricted to the river's lower mile. Within the channel migration zone of the first mile, the construction of road and dikes associated with home development has constrained the channel and floodplain function and potentially reducing pool quality and quantity as well as side channel habitat. Some riparian habitat in the lower mile has been converted to residential development and pasture land. Residential construction on the alluvial fan my lead to a constrained channel in the future. LWD has been removed from the lower mile of the river for flood control and firewood gathering; however, the potential for LWD recruitment is thought to be at natural levels. Lower stream flows are a natural condition throughout the Lost River drainage, but water temperatures remain cold.

2.4.2 Description of Wenatchee and Methow Subbasin Habitats Based on NPCC Habitat Condition Criteria

Based on the habitat descriptions provided by the Wenatchee and Methow River Subbasin Plans (NPCC 2004a and NPCC 2004b), we rated each assessment unit, or watershed within the subbasins, using the criteria for conditions described by the NPCC (NPPC 2000).

The NPCC presents restoration strategies, including artificial production strategies, based on the current condition and the restoration potential of habitat for the species and life stages of interest (NPPC 2000). Generally, for intact habitat where a target population is largely intact, "the biological objective for that habitat will be to preserve the habitat and restore the population of the target species up to the sustainable capacity of the habitat." The NPCC recommends artificial production under the proper conditions, including 1) complementing habitat improvements by supplementing with native fish populations up to the sustainable carrying capacity and 2) replacing lost salmon or steelhead populations (NPPC 2000). Restoration of salmon populations is recommended when a species is experiencing low to no natural production, or as is the case for mid-and upper Columbia River coho, where the natural population has been eliminated. Artificial production for the purpose of restoration is recommended only when the habitat is in good condition or in the process of being restored (NPPC 2000). Within the Wenatchee and Methow basins, the tributaries proposed for coho reintroduction include both "intact" and "restorable" habitat conditions and meet the criteria for implementing an artificial production program for the purpose of restoration. Table 2-2 shows habitat condition for the two subbasins using the NPCC criteria.

Table 2-2. Wenatchee and Methow subbasin habitat conditions

Subbasin	Assessment Unit	Habitat Condition	Description
Wenatchee	Lower Wenatchee River	Compromised	Ecological function or habitat structure substantially diminished
	Mission Creek	Compromised	Ecological function or habitat structure substantially diminished
	Peshastin Creek	Compromised	Ecological function or habitat structure substantially diminished
	Chumstick Creek	Compromised	Ecological function or habitat structure substantially diminished
	Middle Wenatchee River	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Icicle Creek	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Nason Creek	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Little Wenatchee River	Intact	Ecological functions and habitat structure largely intact
	White River	Intact	Ecological function and habitat structure largely intact
	Chiwawa River	Intact	Ecological function and habitat structure largely intact
Methow	Lower Methow River	Compromised	Ecological function or habitat structure substantially diminished
	Middle Methow River	Compromised	Ecological function or habitat structure substantially diminished
	Upper Methow River	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Twisp River	Intact	Ecological function and habitat structure largely intact
	Beaver Creek	Compromised	Ecological function or habitat structure substantially diminished
	Chewuch River	Restorable/ Intact	Potentially restorable to intact status through conventional techniques and approaches
	Early Winters Creek	Intact	Ecological function and habitat structure largely intact
	Wolf Creek	Intact	Ecological function and habitat structure largely intact
	Goat Creek	Restorable	Potentially restorable to intact status through conventional techniques and approaches
	Lost River	Intact	Ecological function and habitat structure largely intact

2.4.3 Description of Wenatchee and Methow Subbasin Habitats Based on Ecosystem Diagnosis and Treatment Method

Coho habitat within the Wenatchee and Methow subbasins was assessed using the Ecosystem Diagnosis and Treatment (EDT) method. EDT is an analytical model which relates habitat features and biological performance to support conservation and recovery planning for salmonids (Lichatowich et al. 1995; Lestelle et al. 2004). EDT incorporates information from empirical observation, local experts, and other models and analyses.

The Information Structure and associated data categories are defined at three levels of organization. Together, these can be thought of as an information pyramid in which each level builds on information from the lower level (Figure 2-3). As we move up through the three levels, we take an increasingly organism-centered view of the ecosystem. Levels 1 and 2 together characterize the environment, or ecosystem, providing the characterization of the environment needed to analyze biological performance for a species. The Level 3 category characterizes the same environment from the perspective of "the focal species" (Mobrand et al. 1997)—in this case, coho salmon. This category describes the biological performance in relation to the state of the ecosystem described by the Level 2 ecological attributes.

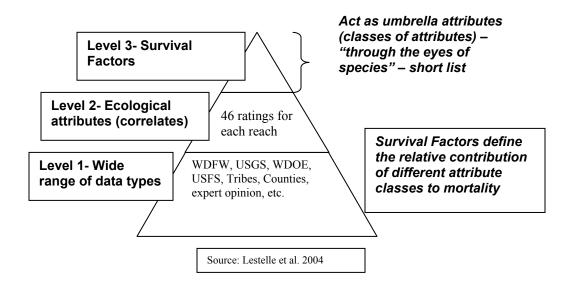


Figure 2-3. Data and Information Pyramid

2.4.3.1 Wenatchee Subbasin EDT Diagnosis for Coho Salmon

The Wenatchee subbasin was divided into 119 stream reaches and 23 obstructions. A stream reach was a segment of river in which environmental, anthropogenic, and biological attributes were relatively constant. The stream reaches were grouped into 19 larger geographic areas or assessment units (AU). A habitat work group consisting of biologists from WDFW, USFWS, USFS, Yakama Nation, Chelan County, and several environmental consulting firms, rated the habitat attributes for the stream reaches within the Wenatchee basin. The work group drew upon published and unpublished data and information. More detail on the processes and habitat ratings can be found in the Draft Upper Columbia Salmon Recovery Plan (UCSRB 2005).

Priority Assessment Units

Based on the average rank and the sum of the **protection benefits** across three performance measures—diversity index, productivity, and abundance—the top assessment units for habitat protection benefits to coho salmon are the Chiwawa River, White River, and Upper Wenatchee River (Chiwakum Creek to Lake Wenatchee). This means that coho in the basin will benefit most from protecting the existing attributes of these three assessment units. Other highly ranking assessment units for coho in the protection category include Tumwater Canyon, Lower Nason Creek (mouth to Gaynor Falls), and the Little Wenatchee River.

Based on the average rank sum of **restoration benefits** across the three performance measures—diversity index, productivity, and abundance—the assessment units which ranked highest in restoration benefits for coho salmon are Lower Nason Creek, Upper Wenatchee River, and the White River. This means that the greatest increases in coho abundance, productivity, and life history diversity would occur if the degraded habitat in these streams was restored. The inclusion of the upper Wenatchee River as a top restoration priority was somewhat unexpected but consistent with the EDT results for spring chinook in the Wenatchee basin. The Chiwawa and White rivers ranked relatively high in restoration benefits to coho productivity, even though they are thought to be in relatively pristine conditions. We conclude that, in this pristine habitat, there are still a few small problems which, if fixed, would substantially increase productivity (C. Baldwin, WDFW, pers comm.). The Chiwawa and White rivers also ranked highest in protection benefits to coho productivity.

Figure 2-4 and Table 2-3 summarize the relative importance of geographic areas for protection and restoration measures.

Wenatchee Coho Relative Importance Of Geographic Areas For Protection and Restoration Measures

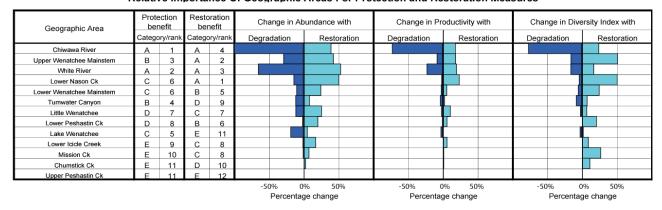


Figure 2-4. EDT Model Output for the Assessment Unit Summary for Wenatchee Coho Salmon

Note: The restoration and degradation potential is the percent change in each of the performance measures (abundance, productivity, diversity) that would take place if all environmental attributes in that assessment unit were either restored or degraded.

Figure 2-4 illustrates which assessment units will be the most important to re-establishing a naturally reproducing coho population. For example, the figure shows that the White River ranks high for coho for protection: its existing habitat qualities make the White the second most valuable river for coho of those evaluated in the Wenatchee subbasin. The figure also shows that, if the attributes of that river are degraded, then coho abundance would be reduced by over 60% (assuming coho occupied that river); and if all the attributes currently at risk were restored, that coho abundance could be increased by 50%. The reaches that ranked highest in protection and restoration values also provided the highest predicted coho productivity (Table 2-3).

Table 2-3. Wenatchee basin coho adult productivity values predicted by EDT

i ubic = 0.	• • ciiatoi	ice basi	ii cono a	auit pi ou	activity	Vuiuco	prodict	ica sy Ei	- .	
Location	White R	Chi- wawa R	Little Wenat- chee R	Wenat- chee R	Nason Ck	Icicle Ck	Pesh- astin Ck	Beaver Ck	Chum- stick Ck	Mission Ck
EDT Predicted Productivity Values	1.6	1.5	1.5	1.3	1.1	<1	<1	<1	<1	<1

Note: Productivity values less than 1 are unlikely to establish naturally reproducing populations.

Stream Reach Analysis

Reach and life stage-specific limiting factors are shown in Figure 2-5. Habitat diversity, obstructions, sediment load, and key habitat quality were primary limiting factors in one or more assessment units (Figure 2-5). Other limiting attributes of lesser importance included channel stability, competition with hatchery fish, flow, and food. The Chiwawa River, White River, Upper Wenatchee River and Lower Nason Creek have no primary limiting factors for coho (Figure 2-5). Primary limiting factors are those attributes ranking "high" in restoration priority. Primary limiting factors were found in Chumstick Creek (obstructions and key habitat quality), Little Wenatchee River (sediment load), Lower Icicle Creek (habitat diversity, obstructions, and sediment load), Lower Peshastin Creek (obstructions), Lower Mainstem Wenatchee (habitat

diversity), Mission Creek (obstructions, sediment load, and key habitat quality), Tumwater Canyon (habitat diversity), and Upper Peshastin Creek (habitat diversity). Assessment units with the fewest limiting attributes will likely be important reaches for coho reintroduction.

Wenatchee Coho
Protection and Restoration Strategic Priority Summary

Geographic area prior						Attri	bute	clas	s pric	ority 1	for re	stora	tion					
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (othersp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Key habitat quantity
Chiwawa River	\circ	0			•			•										•
Chumstick Ck			•				•	•	•	•					•	•		
Lake Wenatchee								•										
Little Wenatchee		0			•			•										•
Lower Icicle Creek			•		•		•	•		•						•		•
Lower Nason Ck		\circ			•		•	•	•						•			•
Lower Peshastin Ck		0	•		•		•	•	•	•					•			•
Lower Wenatchee Mainstem		0	•				•	•							•			•
Mission Ck			•				•	•	•	•								
Tumwater Canyon	0						•	•			•				•			•
Upper Peshastin Ck			•		•		•	•							•			•
Upper Wenatchee Mainstem	0	\circ	•				•	•	•						•			•
White River	0	0						•	•						•			•
1/ "Channel stability" applies to freshwa areas only.	iter		Key	to stra	ategio High		В	Medi	pond	ing B	Low		gory D & E			show Gen		

Figure 2-5. EDT Strategic Priority Summary for Wenatchee Basin Coho Salmon

Note: Prioritized attributes in need of restoration are shown for each assessment unit.

2.4.3.2. Methow Subbasin EDT Diagnosis

Coho habitat within the Methow subbasin was also assessed using the EDT method. The Methow subbasin was divided into 148 stream reaches; the reaches were grouped into 13 assessment units (AUs). A stream reach was a segment of river in which environmental, anthropogenic, and biological attributes were relatively constant. A technical workgroup rated habitat attributes for the stream reaches within the Methow subbasin. The work group drew upon published and unpublished data and information. More detail on the processes and habitat ratings can be found in the Methow Subbasin Plan (NPCC 2004b).

Priority Assessment Units

Based on the average rank and the sum of the protection benefit across three performance measures (as identified in the Wenatchee Diagnosis), the assessment units that ranked highest for habitat protection benefits to coho are the Upper Methow River (Rkm 119.8 - 134.6, including the Lost River and Early Winters Creek), the Upper Twisp River (Rkm 27.8 - 49.9), and the Middle Methow River (Rkm 53.1 - 94.3). The highest ranking assessment units in terms of protection benefits will likely be essential to coho restoration in the Methow basin. Other high ranking assessment units include Upper Middle Methow (Rkm 94.3 - 119.8), Lower Twisp River (Rkm 0.0 - 27.8), and Upper Chewuch River (Rkm 18.1 - 56.0). Assessment units that ranked highest for restoration benefits to coho salmon are Middle Methow River, Upper Chewuch River, and Lower Chewuch River (Rkm 0.0 to 18.1). A summary of relative importance to coho of geographic areas for protection and restoration measures is shown in Figure 2-6.

Methow Coho
Relative Importance Of Geographic Areas For Protection and Restoration Measures

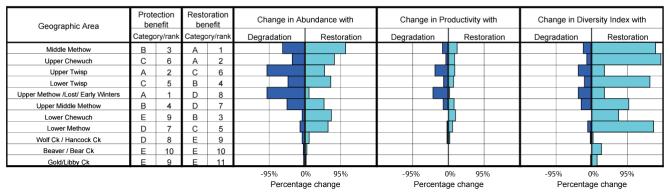


Figure 2-6. EDT Model Output for the Assessment Unit Summary for Methow Coho Salmon

Note: The restoration and degradation potential is the percent change in each of the performance measures (abundance, productivity, diversity) that would take place if all environmental attributes in that assessment unit were either restored or degraded.

As described in the Wenatchee Diagnosis, the reaches that ranked highest in protection and restoration values also provided the highest predicted coho productivity (Table 2-4).

Table 2-4. Methow basin coho adult productivity values predicted by EDT

Location	Lost Twisp Methow River River			Early Winters Creek	Chewuch Creek	Wolf Creek	Beaver Creek	Gold Creek
EDT Predicted Productivity Values	1.4	1.3	1.2	1.2	1.1	<1	<1	<1

Note: Productivity values less than 1 are unlikely to establish naturally reproducing populations.

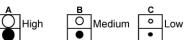
Stream Reach Analysis

Reach and life stage specific limiting factors are shown in Figure 2-7. Habitat diversity was a primary limiting factors in five assessment units (Figure 2-7). Other limiting attributes of lesser importance included channel stability, competition with hatchery fish, flow, food, harassment/poaching, predation, sediment load, and key habitat quality. The Lower and Upper Chewuch River, Lower and Upper Twisp River, Upper-Middle Methow River, and Upper Methow/Lost/Early Winters Assessment Units have no primary limiting factors for coho (Figure 2-7). Primary limiting factors are those attributes ranking "high" in restoration priority. Primary limiting factors were found in Beaver Creek, Gold and Libby Creeks, Lower Methow River, Middle Methow River, Wolf Creek and Hancock Creek. Assessment units with the fewest limiting attributes will likely be important reaches for coho reintroduction.

Methow Coho Protection and Restoration Strategic Priority Summary

Geographic area prior	y Attribute class priority for restoration																	
Geographic area	Protection benefit	Restoration benefit	Channel stability	Chemicals	Competition (w/ hatch)	Competition (other sp)	Flow	Food	Habitat diversity	Harassment/poaching	Obstructions	Oxygen	Pathogens	Predation	Sediment load	Temperature	Withdrawals	Kev habitat quantity
Beaver / Bear Ck			•				•	•							•			•
Gold/Libby Ck			•				•								•			•
Lower Chewuch		0	•		•		•	•	•						•			•
Lower Methow		0	•		•		•			•				•	•			•
Lower Twisp	0	0	•				•		•						•			•
Middle Methow	0	\circ	•		•		•	•		•				•	•			•
Upper Chewuch	0	\circ			•				•						•			•
Upper Methow /Lost/ Early Winters	0								•									•
Upper Middle Methow	0		•		•		•		•	•								•
Upper Twisp	0	0			•				•						•			•
Wolf Ck / Hancock Ck			•				•	•							•			•

1/ "Channel stability" applies to freshwater



D & E	
	Indirect or Genera

Figure 2-7. EDT Strategic Priority Summary for Methow Basin Coho Salmon

Note: Prioritized attributes in need of restoration are shown for each assessment unit.

2.4.4 Planned Habitat Restoration Projects

Over the past two years, the UCSRB has been actively involved in the development of the Upper Columbia Salmon Recovery Plan. The primary focus of this effort is on spring chinook, summer steelhead and bull trout. The EDT methodology was applied to spring chinook and steelhead as the primary means to identify key limiting factors and specific stream reaches within both the Methow and Wenatchee subbasins. A comparison of results for the EDT runs for coho salmon, chinook salmon and summer steelhead indicate a strong correlation of limiting factors affecting these three species. This is not a surprising result since channel simplification resulting in lost key habitat (primarily pools), lost habitat structure/diversity, impeded floodplain function, and disassociation of side channels is evident throughout many important reaches within these two subbasins. Habitat actions addressing these factors will provide substantial benefits to all anadromous fish species at various times of the year and life histories.

As a result of the EDT analysis and identification of the key limiting factors, the UCSRB directed technical staff, representing USFWS, WDFW, USFS, Yakama Nation, Colville Tribes, and all interested stakeholders (including Chelan County Conservation District, Bureau of Reclamation and other entities) to develop a site-specific Implementation Schedule. The Implementation Schedule groups protection actions into discrete categories by assessment unit (watershed):

- 1) water quality,
- 2) flows/hydrology,
- 3) riparian/floodplain condition,
- 4) in-channel habitat conditions,
- 5) habitat quality,
- 6) habitat access, and
- 7) ecological relationships.

Where specific limiting factors have been identified within these categories, site-specific actions and, to the degree practicable, site-specific locations have been described. Additionally, these actions have been sequenced over time, specifically 0-3 years, 3-6 years, 6-10 years and > ten years intervals. In all cases, protection and restoration activities described in the Implementation Schedule are considered by the technical staff to be feasible and appropriate such that this list represents a realistic—even conser-vative—estimate of future actions.

From a technical perspective, the primary purpose of the Implementation Schedule is to allow resource managers to evaluate the effectiveness of proposed actions using the EDT model. Using this model (and in association with the All H Analyzer), resource managers will provide defensible estimates of future habitat changes and will provide useful information in understanding population responses to these changes. Additionally, utilization of this Schedule will better coordinate restoration actions and is intended to provide greater assurance that actions will take place in a timely manner.

It is assumed that adequate funding is available to implement all actions identified in this Schedule and that this Schedule is a reasonable reflection of future restoration actions. This assumption is founded in the fact that both Wenatchee and Methow subbasins will be receiving

directed mitigation funds from not only the BPA Fish and Wildlife Program, but also the Habitat Conservation Plans for Chelan and Douglas PUDs as well as from future relicensing mitigation from Grant PUD. Upon the establishment of the coho program as a long-term (20-25 years) restoration action, additional funding will be available from the Mid-Columbia PUDs as a part of their anticipated mitigation and production obligations. Additionally, the Washington State Salmon Recovery Fund Board (SRFB) has traditionally provided several million dollars per year to the Columbia Cascade Province specifically for salmonid restoration. Other funding sources are EPA, USFWS and tribal Pacific Coast Salmon Recovery Funds which will also play an important role in implementing habitat restoration actions associated with this schedule.

A general summary of the Implementation Schedule is provided below. It is important to note that Tables 2-5 and 2-6 are only summaries and many other actions are anticipated throughout both subbasins. It is the intent of these tables to capture only the key habitat actions in key watersheds. The Salmon Recovery Plan, of which the Implementation Schedule is a part, will remain in draft form until the federal Recovery review and evaluation process is completed, anticipated by December 2006.

Table 2-5. Summary of key actions in the Wenatchee subbasin and estimated time frames for initiation and completion

initiation and coi	Wenatchee Subb	pasin
Primary Assessment Unit	Key Actions	Estimated Timeframe (Beginning in 2007)
Lower Wenatchee River	Side channel reconnection and off- channel habitat restoration. Approximately 20 sites identified in mainstem, of which 4-6 have been identified as highest priority.	High priority sites implemented within the next 10 years progressing as appropriate based upon monitoring conclusions. Other sites developed if feasible and needed.
	Riparian re-vegetation associated with side-channel and off-channel habitat and other areas currently degraded.	Activity would be ongoing and as opportunities arise. Objective to return 75% of riparian to normative condition.
Upper Wenatchee	Culvert replacement in key tributary streams.	All passage issues resolved by year 6 after initiation of Implementation Plan
River	Provide mainstem habitat diversity using large wood complexes.	Survey and engineer work evaluation complete in Year 3, initial implementation and monitoring complete in year 6 and proceed with additional structures as appropriate through year 10. Estimated 15 – 20 structures.
	Riparian plantings in degraded areas	Initiate as soon as possible; estimated 500 lineal feet per year over 10-year period.
Peshastin Creek	Culvert replacement in key tributary streams, three sites identified.	All passage issues resolved by year 6. Mainstem passage above Peshastin Irrigation Canal recently completed.
	Increase habitat diversity with large rock and/or wood structures.	Implement 2-4 structures within next three years and based upon monitoring continue implementation of expected 20 – 30 additional structures by Year 10.
	Development of side-channel habitat in lower mainstem as identified in Channel Migration Zone study. Evaluation of additional side channel habitat in lower mainstem.	Evaluation and implementation estimated between years 6-10, or thereafter.
Lower Icicle Creek	Increase irrigation delivery and use efficiency to increase low summer flows.	Evaluation period estimated to begin in years 0-3. Implementation uncertain at this time.
	Stream bank restoration and associated riparian plantings to reduce sediment yield and increase habitat diversity.	Evaluation of overall need and strategy and initial implementation anticipated prior to year 6. Estimated to continue 500 lineal stream bank implementation to restore all stream banks where feasible.
	Obstructions removal from LNFH to boulder field at RM 8.	Progress in ongoing and expected to be completed prior to year 6.

Primary Assessment Unit	Key Actions	Estimated Timeframe (Beginning in 2007)
Lower Nason Creek	System-wide approach to restore channel function, diversity and side channel habitat. Focus on lower 12 miles of mainstem.	Bureau of Reclamation has initiated system- wide evaluation with regards to channel morphology and condition. Nason Creek noted as primary focus of habitat restoration in Wenatchee Subbasin. Evaluation completed in Year 3 and implementation schedule will be developed at that time.
	Passage to Coulter, Roaring, Mill, and Roaring creeks	Evaluation of desired action expected prior to year 3, full implementation expected prior to year 6.
	Nutrient enhancement through analog and/or hatchery carcasses.	Evaluation and implementation/monitoring design prior to year 3.
White River	Nutrient enhancement through analog and/or hatchery carcasses.	Evaluation and implementation/monitoring design prior to year 3.
	Improvement of habitat diversity through conservation easements and modest enhancement where appropriate. Watershed approach to restore side channel/off channel function	Acquisition of easements on-going and anticipated to continue through the next 10 years.
Chiwawa River	Riparian and side/off channel enhancements and protection of key habitat through increased management actions associated with recreation use and road management on USFS lands.	Implementation of these activities is ongoing and anticipated to be largely competed prior to year 10.
	Nutrient enhancement through analog and/or hatchery carcasses.	Evaluation and implementation/monitoring design prior to year 3.

Table 2-6. Summary of key actions in the Methow subbasin and estimated time frames for initiation and completion

initiation and cor	Methow Subbas	in
Primary Assessment Unit	Key Actions	Estimated Timeframe (Beginning 2007)
Lower Methow	From Winthrop to Twisp, and at a few locations downstream of Twisp and upstream of historic town site of Silver, reestablish natural off channel storage capacity areas by reconnecting side channels, wetlands, beaver ponds.	BOR is currently evaluating these areas for future project implementation. Design and engineering is anticipated prior to year 3 and implementation of actions is scheduled for years 3-6.
	Re-establishment of floodplain function and riparian vegetation / cottonwood forests to enhance habitat quality and improve water temperatures. Areas currently being identified through BOR evaluation.	Same as above. Re vegetation expected to be ongoing through year 10 of this Implementation Schedule.
	Habitat protection in areas with intact functioning systems.	Action is ongoing and relatively aggressive through local land trusts.
Upper Middle and Upper Methow	Improve and protect existing intact and functioning riparian and floodplain habitat within Early Winters and near Lost River airport through establishment of flood channels and side channels where appropriate and acquisition of land or conservation easements.	System wide assessment is needed, time frame anticipated in years 0-3
	Reduce sediment through USFS road maintenance and management plan.	Assess and design in years 3-6 and implement as appropriate thereafter.
Upper/Lower Twisp	Enhancement of water quality through improvements in irrigation efficiency and instream flow and enhancement of riparian vegetation.	Assessment is ongoing and specific timelines are not available at this time. Associated with BOR watershed evaluation. Implementation expected prior to year 10.
	Removal or modification of levees or dikes as appropriate. Four possible locations identified on USFS locations.	Assessment scheduled for years 0-3. Implementation Schedule is not yet defined. Associated with BOR watershed evaluation. Implementation expected prior to year 10.
	Fence wetland and riparian areas on USFS lands to allow recovery from grazing and promote beaver re-colonization.	Design and implement within years 0-3.
	Acquisition through purchase or conservation easements to protect and enhance side and off channel structure, diversity and riparian function.	Ongoing.

Primary Assessment Unit	Key Actions	Estimated Timeframe (Beginning 2007)
Upper/Lower Chewuch	Improve water quantity / storage and habitat complexity on all tributaries and mainstem through re-establishment of beaver colonies.	Initiate in year 0-3 and maintain active program to promote action.
	Improve riparian habitat through livestock enclosures within four identified subwatersheds.	Design and implement within years 0-3.
	Improve sediment levels through road management on USFS system.	NEPA and associated planning initiated in years 0-3 with implementation of priority actions beginning in year 4-6.
	Eradication or control of brook trout within the system.	Evaluate options and plan development in years 0-3 and implement as appropriate.

Chapter 3. Summary of Feasibility Study Results and Resolution of Critical Uncertainties



- 3.1 Benefits to Coho
- 3.2 Risks to Other Species

Chapter 3. Summary of Feasibility Study Results and Resolution of Critical Uncertainties

Studies to determine the feasibility of reintroducing coho into mid-Columbia basins began in 1996. In response to a National Marine Fisheries Service Biological Opinion (NMFS 1999), a Hatchery and Genetics Management Plan (HGMP) was prepared in 1999 which outlined goals, objectives, and study plans. As studies progressed, project participants and the Mid-Columbia TWG⁵ refined the study objectives, which are outlined in a revised version of the HGMP (YN et al. 2002). Feasibility studies were designed to achieve two primary goals:

- 1) Determine whether a broodstock can be developed from lower Columbia River coho stocks whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region.
- 2) Initiate natural reproduction in areas of low risk to sensitive species and in other select areas to study the risks and interactions with sensitive species.

Project performance indicators were developed to measure success at achieving the goals (Section 1.10 of the 2002 HGMP). Indicators were divided into those that measured benefits to coho and those that measured risks to other species.

Benefits to coho

- Trends in survival of hatchery coho as measured by PIT tags (smolt-to-smolt), and by counts at dams/facilities and CWTs (smolt-to-adult).
- Spatial distribution of returning adults in potential natural spawning areas as identified from radio telemetry, foot/boat redd surveys, and weirs.
- Reproductive success (initial evaluations only) of naturally reproducing coho using redd counts and smolt production estimates.
- Changes made by out-of-basin stock, using genetic monitoring of neutral allelic frequencies; and phenotypic traits such as fecundity, body morphometry, maturation timing, and straying and homing to acclimation sites.

Risks to other listed species

• Predation on other species (spring chinook and sockeye fry) by program hatchery fish as indicated by stomach content analyses.

- Residualism studies as determined through snorkel surveys.
- Superimposition of spring chinook redds by spawning coho as measured by superimposition studies and spawning ground surveys.
- Competition for food and habitat during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations, in habitat with and without coho.

⁵ Current TWG members include Bonneville Power Administration, Confederated Tribes of the Colville Indian Reservation, Nez Perce Tribe, NOAA Fisheries, U.S. Fish and Wildlife Service, Northwest Power and Conservation Council, U.S. Forest Service, Chelan and Douglas County Public Utility Districts.

 Predation by naturally produced coho on spring chinook fry through trapping and stomach analysis.

This chapter is only a summary of feasibility study results—full details are provided in the cited documents.

3.1 Benefits to Coho

Feasibility Goal 1) Determine whether a broodstock can be developed from lower Columbia River coho stocks whose progeny can survive in increasing numbers to return as adults to the mid-Columbia region.

To test whether this goal could be met, researchers used as performance indicators coho survival at various stages, the spatial distribution of returning adults, and to a limited degree, reproductive success. Genetic changes had been proposed as a performance indicator in the HGMP, but genetic studies were not funded. Study results are described in sections 3.1.1 and 3.1.2. Two generations of broodstock development have occurred to date. Lower Columbia River coho stocks are no longer released in the Wenatchee River.

3.1.1 Coho survival

The Mid-Columbia Coho Reintroduction Feasibility Study began in 1996 with acclimated releases of reprogrammed lower Columbia River stocks in the Methow River. In 1999 the focus of the feasibility study shifted to the Wenatchee River basin due to low smolt-to-adult survival rates (SARs) and a lack of suitable broodstock collection facilities in the Methow River. Acclimated coho releases in the Wenatchee basin began with coho pre-smolts reprogrammed from lower Columbia River facilities; since then, the feasibility program has transitioned to 100% local brood collected in both basins. Second generation mid-Columbia brood coho are currently being reared at Winthrop NFH, Cascade FH, and Willard NFH (Table 3-1).

Evidence that this approach is working comes from data collected during the feasibility phases of the mid-Columbia and Yakima River coho reintroduction programs. An important measure of the effect of local adaptation is smolt-to-adult return rate. Figure 3-1 from Corps of Engineers' smolt and adult data at McNary Dam indicates that this rate is increasing rapidly for all coho programs above this dam (mid-Columbia, Umatilla River and Yakima River).

Table 3-1. Broodstock collected and smolts produced

Brood Year	Release Year	Basin	Brood Source	Adult Return Year	Broodstock Collected	Mid-Columbia Smolts Produced
1996	1998	Methow	LCR	1999	150*	143,000
1997	1999	Wenatchee	LCR	2000	919	585,000
1998	2000	Wenatchee	LCR	2001	1219	738,900
		Methow	LCR	2001	334	162,800
1999	2001	Wenatchee	LCR & MCR	2002	213	133,000
		Methow	LCR	2002	52	22,000
2000	2002	Wenatchee	MCR & LCR	2003	1706	1,064,000
		Methow	LCR	2003	208	65,000
2001	2003	Wenatchee	MCR	2004	1450	1,468,000
		Methow	LCR	2004	118	45,000
2002	2004	Wenatchee	MCR & LCR	2005	1406	1,382,900
		Methow	LCR	2005	345	246,958
2003	2005	Wenatchee	MCR	2006	N/A	N/A
		Methow	MCR & LCR	2006	N/A	N/A
2004	2006**	Wenatchee	MCR**	2007	N/A	N/A
		Methow	MCR**	2007	N/A	N/A

^{*} Indicates number spawned and not total number of broodstock collected.

** 100% second generation mid-Columbia brood origin smolts will be released in both basins in 2006.

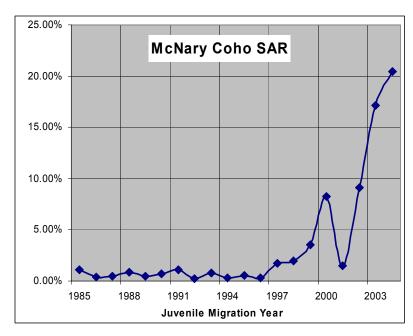


Figure 3-1. Coho SARs at McNary Dam

(calculated from juvenile passage indices and adult counts)

Figure 3-2 shows SARs for coho returns to the Wenatchee and Methow rivers. During 2001 and 2002, SARS in the Wenatchee and Methow basins were similar; both were SARs for reprogrammed lower Columbia River stocks. During 2003 and 2004, first-generation mid-Columbia brood coho returned to the Wenatchee River; reprogrammed lower Columbia brood returned to the Methow. It should be noted that the 2002 low adult return rate is a direct result of the drought year of 2001, which resulted in poor smolt migratory conditions and extremely high smolt-to-smolt mortality rates.

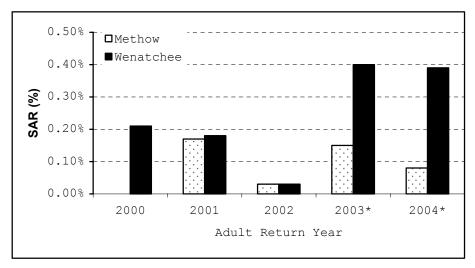


Figure 3-2. Smolt-to-Adult Survival Rates for Hatchery Coho in the Methow and Wenatchee Rivers

^{*}During 2003 and 2004, first-generation mid-Columbia brood coho returned to the Wenatchee River; all other returns represent reprogrammed lower Columbia River stocks.

In 2002 (BY 2000) and 2003 (BY 2001), we released differentially coded-wire-tagged lower Columbia brood (LCR) and first generation mid-Columbia brood (MCR) from Dam 5 on Icicle Creek, to determine if a survival advantage can be observed with one generation of broodstock development. Both groups were reared at lower Columbia facilities and were acclimated in the same pond, for the same duration of time. Figure 3-3 shows that SARs for BY 2000 and BY 2001 were higher for mid-Columbia brood (0.53% and 0.56%;) than for lower Columbia brood (0.31% and 0.45). In both years, results of a z-test for differences in proportions indicated that mid-Columbia brood survive at statistically higher rates than reprogrammed lower Columbia brood coho.

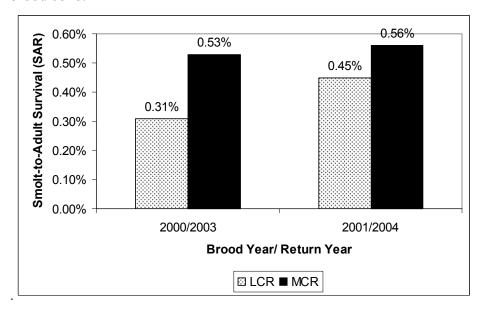


Figure 3-3. SARs for Reprogrammed LCR Brood and First-generation MCR Brood Reared at Lower Columbia Facilities

The feasibility phase demonstrated that a local broodstock can be developed from lower river stocks. It appears that a survival advantage can be achieved with one generation of selection. Our proposal uses methods that are expected to encourage a continuation of the selection process, eventually resulting in a locally adapted population (Chapters 4 and 5). We expect to continue to see increases in survival as local adaptation progresses.

3.1.2 Spatial distribution of returning adults

During the feasibility phase, extensive spawning ground surveys and radio-telemetry studies documented spawning escapement and distribution. In 2000, 2001, and 2002, spawning ground surveys focused on the Wenatchee River basin; they expanded to include the Methow basin in 2003 and 2004. Figure 3-4 shows the number and distribution of redds in the Wenatchee River.

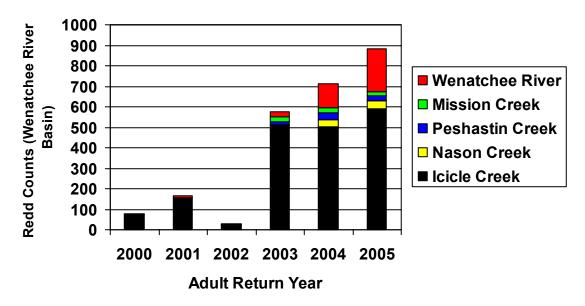


Figure 3-4. Number and Distribution of Coho Redds in Wenatchee Basin, 2000 - 2005

With data collected from a WDFW-operated rotary smolt trap on the Wenatchee River, we estimated the population size of naturally produced coho smolts emigrating from the Wenatchee River and calculated an egg-to-emigrant survival rate (Table 3-2). This egg-to-emigrant survival rate can be viewed as a maximum rate, because unidentified coho redds cannot be accounted for in this estimate. The egg-to-emigrant survival rates observed for naturally produced coho comport well with those observed for spring chinook in the basin. The egg-to-emigrant survival rate for spring chinook in the Chiwawa River has ranged from 4.7% to 18.1% over the last ten years (Miller 2003). Table 3-2 demonstrates that observed redds are producing smolts and the smolts are returning as adults.

Table 3-2. Natural coho production in the Wenatchee river, Brood Years 2000-2004

Brood Year	Redds	Natural Smolt Estimate ¹	Egg-to- Emigrant Survival ²	Smolt-to-Adult Survival
2000	77	17,054	8.20%	0.37% ³
2001	165	36,678	8.65%	$0.40\%^{2}$
2002	28	5,826	9.80%	N/A
2003	625	N/A	N/A	N/A
2004	714	N/A	N/A	N/A

¹ Natural coho smolt production estimate provided by T. Miller (WDFW unpublished data).

² Egg-to-emigrant survival should be viewed as a maximum due to the possibility of unidentified and uncounted coho redds.

³ Smolt-to-adult survival rate based on scale analysis by J. Sneva (WDFW).

3.2 Risks to Other Species

Feasibility Goal 2) Initiate natural reproduction in areas of low risk to sensitive species and in other select areas to study the risks and interactions with sensitive species.

As planned in the HGMP (YN et al. 2002), critical uncertainties regarding species interactions were investigated. The issues identified in the HGMP are as follows:

- 1) rate of predation by hatchery coho on spring chinook fry,
- 2) rate of predation by hatchery coho on sockeye fry,
- 3) superimposition of spring chinook redds by spawning coho,
- 4) rates of residualism, and
- 5) competition for space and food during freshwater rearing of naturally produced coho juveniles as measured through micro-habitat use and growth evaluations.

The HGMP also identified the need for additional studies of interactions between naturally produced coho and listed and sensitive species, if sufficient numbers of naturally produced coho allowed a meaningful study to be conducted.

The studies summarized below answered a number of the critical uncertainties identified in the feasibility phase. However the question of predation rates by *naturally* produced coho on spring chinook fry remains. We will answer this question during the NPIP as part of the proposed M&E plan (see Chapter 7).

With the completion of many species interaction evaluations and most critical uncertainties answered, the monitoring and evaluation plan (Chapter 7) is designed to coordinate the coho reintroduction effort with other ongoing programs, such as the Chelan and Douglas PUD HCP Hatchery Compensation M&E Plan and the Integrated Status and Effectiveness Monitoring Program (BPA Project # 2003-017-00), to monitor the status of listed and endangered species. Much of the data previously or currently being collected by this program, or that is currently proposed by other programs, can be used to help detect negative effects, if any, of coho reintroduction

3.2.1 Predation by Hatchery Coho on Other Species

Predation by hatchery coho on spring chinook fry

During the feasibility phase, the YN completed three predation evaluations in the During the feasibility phase, the YN completed three predation evaluations in the Wenatchee Basin and two predation evaluations in the Yakima River. Methods for all five studies were similar and are detailed in Dunnigan (1999), Murdoch and Dunnigan (2002), Murdoch and LaRue (2002), Murdoch et al. (2005). Hatchery coho smolts released from acclimation sites were recaptured at a smolt trap downstream. The distance downstream varied in each tributary and depended upon the location of the acclimation site and distribution of chinook redds and fry. The protocols specified that all fish be removed from the live box hourly. The frequent removal of coho from the trap was intended to minimize predation within the live box. The target sample size of coho in each study (approximately 1,000) was collected from throughout the run and retained for stomach content analysis. We estimated the incidence of predation, gastric evacuation rate, and residence time; these factors allowed us to estimate the total number of prey items consumed.

Murdoch and Dunnigan 2000. In 2000 we completed a study to measure predation on summer chinook fry by hatchery coho smolts volitionally released into the Icicle River and recaptured at a rotary smolt trap operated by WDFW on the Wenatchee River (RM 7.1) (Murdoch and Dunnigan 2002). The total migration distance from release to recapture was 21.3 miles and included some of the highest densities of chinook redds and subsequent fry emergence in the Wenatchee River. We observed an incidence of predation of 0.006 (95%CI 0.0016-0.0154). We estimated the total number of summer chinook fry consumed based on the gastric evacuation rate of 30.2 hours and a residence time of 16.5 days. Because the release was volitional, we had no way of accurately calculating residence time in the Wenatchee River. We used the day the volitional release began to the date of mean catch at the trap. Because it took approximately three weeks for all the fish to leave the pond, we believe the model over-estimates the total number of fish consumed due to the known overestimate in residence time. We estimated the total number of summer chinook fry consumed to be 134,125 or 1.31% (95% CI 0.36% to 3.35%) of the total summer chinook fry population. This rate of predation is higher than studies of predation by hatchery coho on spring chinook fry, presumably because of the greater abundance and availability of summer chinook fry. Similar studies have shown that the rate of predation is higher with greater abundance and densities of prey (Hawkins and Tipping 1999; Hawkins 2002).

Murdoch and LaRue 2002. In 2001, YN completed a study to measure predation on spring chinook fry in Nason Creek (Murdoch and LaRue 2002). We volitionally released coho smolts from the Butcher Creek acclimation pond (RM 8.1 on Nason Creek) and recaptured the smolts in a rotary smolt trap located at RM 0.8 on Nason Creek. We observed an incidence of predation of 0.0018 (95%CI 0.0002-0.0066). We estimated the total number of summer chinook fry consumed based on the gastric evacuation rate of 40.5 hours and a residence time of 15.8 days. As during the 2000 evaluation, we used the date the volitional release began and mean catch at the trap to estimate residence time. This method likely resulted in an over-estimate of residence time, because it typically takes approximately three weeks for most of the fish to leave the pond. We estimated the total number of spring chinook fry consumed to be 2,436 or 0.96% (95% CI 0.12% to 3.5%) of the total spring chinook fry population in Nason Creek.

Murdoch et al. 2005. In 2003, YN repeated the 2001 predation evaluation in Nason Creek. We added PIT tag detectors to the outlet of the Butcher Creek pond and scanned all recaptures at the trap for the presence of PIT tags. This allowed us to calculate the actual residence time for hatchery coho in Nason Creek and to produce an accurate estimate of the total number of fish consumed. We observed an incidence of predation of 0.0028 (95%CI 0.0006-0.0082). We estimated the total number of spring chinook fry consumed based on the gastric evacuation rate of 40.5 hours and a residence time of 1.7 days. The estimated number of spring chinook fry consumed was 1009 or 0.14% (95% CI 0.03% to 0.4%) of the total spring chinook fry population in Nason Creek. The 2003 predation evaluation probably produced the most accurate results due to our ability to measure residence time with PIT tags. Predation evaluations in the Yakima River have produced similar results (Dunnigan 1999).

Predation/Interactions: hatchery coho and sockeye fry

During 2001, 2002, and 2003 we investigated the distribution of sockeye fry in Lake Wenatchee and the migration timing and patterns of coho smolts migrating through the lake to determine if hatchery coho have the opportunity to encounter and prey upon sockeye smolts (Murdoch and

LaRue 2002; Murdoch et al. 2004; Murdoch et al. 2005). We used radio-telemetry to track the migration of coho smolts through the lake and hydroacoustics, tow netting, and snorkeling to determine the distributions and diel movements of sockeye fry within the lake.

We found that upon entering Lake Wenatchee, sockeye fry rapidly assume a pelagic existence. The results of the hydroacoustics and tow netting indicated that during the day sockeye fry were primarily found below 45 meters. At night the fry moved towards the surface and shoreward. Coho appeared to migrate primarily through littoral areas. The sockeye fry entered the pelagic zone of the lake shortly after emergence and assumed daily vertical migrations typical in other sockeye rearing lakes. Based on the results of the 2002 and 2003 evaluations (Murdoch et. al. 2004; Murdoch et. al. 2005) we believe that the predation risk for sockeye salmon fry by hatchery coho smolts is low. Because of the diel vertical movements of the fry, the greatest opportunity for hatchery coho to encounter a sockeye fry is at night when coho feeding ceases (Sandercock 1998). Crepuscular periods may present limited opportunity for predation.

To verify our conclusion, we initiated a predation evaluation in 2003. Hatchery coho smolts were released from the Two Rivers Acclimation Site on the Little Wenatchee River (RM 1.5), migrated through Lake Wenatchee and were recaptured and retained for stomach analysis in a smolt trap located approximately 0.5 RM downstream from Lake Wenatchee. No coho collected for stomach content analysis contained fish remains (Incidence of Predation = 0.0), although samples sizes were much lower than desired (72 samples collected) due to low trap efficiency (<0.5%), rendering the results inconclusive.

3.2.2 Superimposition by Coho on Spring Chinook Redds

In 2001 we initiated a study to evaluate superimposition of spring chinook redds by spawning coho. For this study, we triangulated the precise location of spring chinook redds in Nason Creek, to ensure that chinook redds could be located a month or more later while coho were spawning. We triangulated the locations of 50 spring chinook redds in two study reaches. For each identified coho redd, any chinook redds nearby were relocated, and the percentage of superimposition, if any, was visually estimated. In 2001 three coho redds were counted in Nason Creek and none had superimposed on spring chinook redds. Since 2001, to determine chinook redd locations, we have relied on CCPUD or WDFW to flag chinook redds with a location description on the flagging; we then followed our previous procedure to identify coho superimposition. We have observed no redd superimposition in Nason Creek. While it is possible that superimposition could occur with increased spawner densities of both chinook and coho, in general, coho appear to select smaller gravels and different habitat types (edges vs. pool tail outs) for spawning.

3.2.3 Rates of Residualism

In 2000 and 2001 we completed comprehensive and systematic snorkel surveys to determine rates of residualism in hatchery coho. In 2000 we completed three surveys of Icicle Creek; each survey sampled approximately 20% of the available habitat. During the first survey (July 5) we observed 4 residual coho (expands to 20 when the sample rate is accounted for). During the second survey (July 24) we observed no residual coho. During the final survey (August 3) we observed one residual coho (expands to 5). We completed two surveys in Nason Creek. Each survey sampled approximately 20% of the available habitat. We found no residual coho during either survey. We repeated the surveys in 2001. In 2001 we sampled 20% of the available habitat in Icicle Creek and observed 2 residual coho (expands to 10). We sampled approximately 28% of the available habitat in Nason Creek and found no residual coho. Snorkel surveys were also conducted in the Methow River with similar results.

Due to the low estimates of hatchery coho residuals, it is unlikely that the residuals were ecologically capable of negatively impacting any species present unless the environment was at or exceeding the natural carrying capacity.

3.2.4 F2 Interactions

Competition for food and habitat

The YN completed two replicate studies to examine microhabitat use by juvenile coho, chinook, and steelhead (Murdoch et al. 2004; Murdoch et al. 2005). The purpose of these studies was to investigate habitat use and growth of spring chinook, steelhead and coho salmon in Nason Creek, Washington, with the specific objective to determine the potential for naturally produced juvenile coho salmon to negatively impact spring chinook salmon and steelhead parr through competition for space and food. Due to the low numbers of naturally produced coho in Nason Creek during the feasibility phase of the reintroduction effort, we out-planted approximately 33,000 hatchery coho fingerlings in Nason Creek for the competition evaluations. While the scatter-planted coho salmon are of hatchery origin, they served as a surrogate for naturally produced coho, providing valuable information regarding interactions between juvenile coho, chinook and steelhead. Scatter-planting densities were based on the estimated carrying capacity and temporary coho escapement limits (memo from Tim Tynan, NMFS-SFD and Laurie Weitkamp-NWFSC, June 29, 2001). The estimate was provided by Tom Cooney (NMFS-UCR TRT). The study designs were reviewed and approved by the mid-Columbia coho TWG. During the course of both studies we collected data on distribution, macrohabitat preference, microhabitat use in control and treatment reaches, and growth of age-0 spring chinook salmon, age-0 coho salmon, and yearling steelhead. During the studies, we collected micro-habitat data on 4,968 juvenile chinook, 729 juvenile coho, and 254 juvenile steelhead.

We found that coho, chinook, and steelhead select different microhabitats. Coho did not appear to displace chinook or steelhead from preferred microhabitats (there was no difference in microhabitat use by chinook and steelhead prior to, and after, coho scatter-planting) (Murdoch et al. 2004; Murdoch et al. 2005). The presence of coho in the treatment reaches did not affect the growth or condition factor of chinook or steelhead. The extensive data collected during both years lends convincing evidence that the reintroduction of juvenile coho, at accepted densities, is unlikely to negatively affect chinook or steelhead through competition for space and food. The microhabitat selection results we observed are consistent with other studies and have been well supported in the literature (Hartman 1965; Lister and Genoe 1970; Allee 1981; Glova 1987;

Bisson et al. 1988; Spaulding et al. 1989; Murphy et al. 1989; Bugert and Bjornn 1991; Taylor 1991a; Mullan et al. 1992; Nickelson et al. 1992; Beecher et al. 2002; Hicks and Hall 2003; Riley et al. 2004).

Predation by naturally reared coho on spring chinook fry

During July 2002, approximately 33,000 coho parr were scatter-planted in Nason Creek between RK 3.0 and 13.0. Details on scatter-plant location and numbers can be found in Murdoch et al. 2004. The scatter-planted coho over-wintering in Nason Creek were recaptured in the rotary smolt trap described in Section 3.2.1. Trap operation began the second week of March and continued until mid-June. The scatter-planted coho were identified by an adipose clip and verified in the lab through coded wire tag (CWT) recovery. During the predation evaluation, all naturally reared coho and naturally produced coho were retained for stomach content analysis. In lieu of a measured residence time, an estimated "predation window" was used in the expansion equations described in Murdoch et al. 2005. The predation window was calculated as the time between mean chinook fry emergence, as measured by tracking temperature units and verified by catch at the trap, and mean passage of scatter-planted coho at the trap.

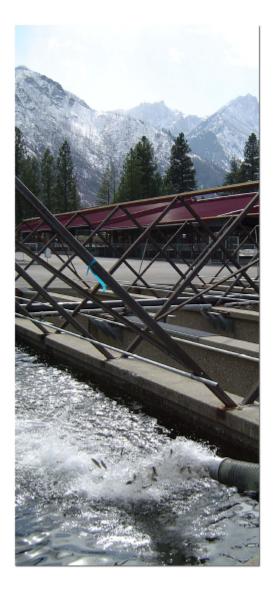
During the study, 37 naturally reared coho smolts were captured in the rotary smolt trap (mean FL = 108.9 mm; standard deviation = 13.9). All were retained for stomach content analysis. Of the 37 coho, one had consumed a fish, which was not positively identified as a spring chinook fry (Murdoch et al. 2005). We analyzed the data as a "worst case scenario" by assuming that the prey fish collected were confirmed as spring chinook.

Results of the stomach content analysis indicate that naturally reared coho fed primarily on insects. Of all the naturally reared coho samples collected during the study (n=37), 28 (75.7%) contained insects. Five (13.5%) of the samples were empty, 5 (13.5%) contained plant material, 1 (2.7%) contained fish, and 2 (5.4%) were unidentifiable (likely detritus or other digested fish food).

After expanding the incidence of predation by the "window of predation," estimated gastric evacuation rate, and the estimated number of naturally reared coho in the river during the study, we estimated the total number of spring chinook fry consumed to be 1,265 or 0.17% of the spring chinook fry population in Nason Creek.

The small sample size of naturally reared coho may not have resulted in an accurate estimate of the incidence of predation. Results of a z-test for differences in proportions indicate no significant difference in the incidence of predation between naturally reared and hatchery coho (p=0.31). Reasons the rate of predation could be higher for naturally produced coho than for hatchery coho include increased residence time (increased opportunity to consume spring chinook fry), and dietary differences as a result of natural rearing. Because naturally produced coho are smaller than hatchery coho, their ability to consume a spring chinook fry may be size-limited. An accurate measure of predation by naturally produced coho smolts on newly emerged spring chinook fry may not be possible until more natural coho are produced in tributaries containing spring chinook.

Chapter 4. Overview of Proposed Program and Alternatives



- 4.1 Introduction
- 4.2 Issues/Alternatives
 Considered in Program
 Development
- 4.3 Proposed Program
- 4.4 Program Risks
- 4.5 Program Benefits

Chapter 4. Overview of Proposed Program and Alternatives

4.1 Introduction

Feasibility study results, as summarized in Chapter 3, demonstrate that coho can be successfully reintroduced into mid-Columbia basins.

For the following reasons, the YN proposes to continue and expand the reintroduction program over the long term.

- Coho are returning to the Wenatchee and Methow basins and reproducing naturally in the Wenatchee River, Icicle Creek, and the Methow River.
- We have demonstrated that it is possible to develop a local broodstock from Lower Columbia River stocks. The program no longer relies on transfers of Lower Columbia River coho to the Wenatchee River. In 2005, the entire smolt release in the Wenatchee basin consisted of second-generation mid-Columbia brood. In 2006, only secondgeneration mid-Columbia brood coho will be released in both the Methow and Wenatchee basins.
- Studies have shown little or no risk of adverse ecological interactions between hatchery-produced coho and listed and sensitive species in these basins.
- Reintroducing coho meets restoration goals as laid out in the Columbia River Anadromous Fish Tribal Fish Restoration Plan, Wy-Kan-Ush-Mi Wa-Kish-Wit (CRITFC 1995).
- Agreements under *U.S. v. Oregon* entitle YN to releases of 1.5 million coho in mid-Columbia basins. YN and WDFW believe that establishing self-sustaining and naturally reproducing populations of a locally adapted stock is more ecologically sound and more likely to allow the program eventually to be terminated than if fish are produced under a traditional harvest augmentation program.

The resource co-mangers, YN and WDFW, have established a goal of reintroducing naturally reproducing coho in Wenatchee and Methow tributaries. While questions remain, the co-managers believe the feasibility studies demonstrate that they are questions of *how best* to achieve the goal of reintroducing a naturally reproducing, locally adapted coho population, rather than *whether* it can be done. (YN/WDFW letter to NPCC, 8/16/04).

4.2 Issues/Alternatives Considered in Program Development

In this section, we present the background for how and why the proposal was developed.

4.2.1 Alternatives Considered

As the feasibility studies neared their conclusion and began showing encouraging results, program managers considered how to proceed. Initially, overall program options appeared to fall into three broad categories:

- 1) Take no further action to restore coho
- 2) Continue feasibility studies
- 3) Pursue approval and funding for a traditional (non-experimental) supplementation-style program.

The option to **take no further action** is not a reasonable alternative, given the successes to date. In addition, it is not a cost-effective or ecologically sound use of *U.S. v. Oregon* fish, nor does it effectively meet tribal restoration goals, goals in the recently completed subbasin plans, or a variety of policy guidance from the last several years that endorses re-establishment of coho in mid-Columbia tributaries. While some natural reproduction is taking place in the Wenatchee and Methow basins, it is too limited to ensure self-sustaining populations in those areas. Simply planting un-acclimated fish in those basins without continuing to develop a locally adapted broodstock would be spending limited funds and resources on producing fish that experience has shown survive at lower rates than locally adapted fish. Concerns about the effect of naturally reproducing coho on listed species in the basins would not be addressed without a monitoring program in place.

The option to **continue feasibility studies** is not necessary or cost-effective because feasibility questions have been answered—coho will survive to return to mid-Columbia basins, a locally adapted broodstock is being developed, and risks to other species from hatchery fish have been shown to be low.

To date, the template for a **traditional supplementation program** can best be described as establishing some production goal (rarely habitat-based), designing and constructing facilities to achieve that goal, followed with monitoring and evaluation activities to determine if the goal was achieved. The long-term facility/program footprint would be established and permanent prior to any results from monitoring and evaluation that could significantly alter or terminate part or all of a program.

Initially, YN considered proposing a traditional supplementation program in three basins—in the Wenatchee and the Methow, as well as in the Entiat (which was part of the long-term vision from the outset). However, co-managers and members of the TWG raised several concerns, including:

- the costs of a program to reintroduce a non-listed species when the regional focus seems to be on restoring listed fish.
- the concern that effects of naturally reproducing coho on listed species had not been effectively studied because adequate numbers of such coho were not yet available to allow a statistically meaningful study;

• the desire of resource managers, to maintain the Entiat as a reference basin by not introducing additional species at this time.

4.2.2 Rationale for Proposed Program

To balance the concerns raised by WDFW and the TWG with the encouraging results from the feasibility studies and the long-standing policy goals related to coho, the original plan was modified.

- The current proposal differs from the traditional approach in that it allows for potential program changes as a result of monitoring and evaluation. The basic concept is to initially minimize the impact of the facility footprint (see Sections 4.3.2 and Chapter 6), and to evaluate what does or does not work in achieving project goals by using or modifying existing facilities in the early program phases. This approach allows evaluation and adaptive management, which in turn enables new facility development to proceed in a cost-effective manner.
- The proposal calls for studies of effects of naturally reproducing coho on listed species, when numbers of naturally produced coho are sufficient to undertake such studies (Sections 4.3.3 and 7.2). They would be preceded by baseline monitoring of listed and sensitive species, to allow proponents to determine whether the status of sensitive species changes as coho numbers increase.
- The proposal includes contingency plans for considering a change in direction, focus, or specific activities of the program based on monitoring results at several key stages (Section 4.3.5).
- With limited resources for the program and the limited natural production potential in the Entiat, at this point the program will focus on the subbasins with more habitat potential—the Wenatchee and Methow.
- The proposed program terminates when restoration goals are met.

The proposal attempts to balance political, practical, and ecological concerns. The Yakama Nation has a treaty right, under the Treaty of 1855, to take fish in usual and accustomed places. This means that fish runs must pass those usual and accustomed places; coho do not now pass such places in the mid-Columbia in harvestable numbers. Because the U.S. v. Oregon process promotes exercise of the Yakama Nation's treaty rights, the Northwest Power Act requires the Council's Fish and Wildlife Program and implementing activities to be consistent with U.S. v. Oregon requirements (16 U.S.C. Sec. 839b(h)(6). The Columbia River Fish Management Plan, which implements U.S. v. Oregon directives, allocates a certain number of coho to mid-Columbia basins. The Yakama Nation believes that developing these fish into naturally reproducing populations is a more ecologically sound and ultimately cost-effective method of attempting to restore treaty rights related to coho, and will, in the long-term, result in more significant opportunities for both tribal and non-tribal harvest, than simply dumping them into mid-Columbia tributaries will ever achieve. Despite the money spent on previous traditional coho hatchery programs in the basins, little or no harvest occurred in mid-Columbia tributaries that were usual and accustomed fishing places for Yakamas. The Tribal Restoration Plan has included a goal of restoring coho populations since 1995. Furthermore, the recent Methow and Wenatchee subbasin plans both name coho as focal species.

At the same time, Yakama Nation and WDFW recognize the importance of ensuring other species are not adversely affected. Spring chinook, for example, are extremely important culturally to the YN, as they are to other tribes and to non-tribal fishers. The YN has no desire to reintroduce coho at the expense of spring chinook, steelhead, or other fish species. Yet, in practical terms, continuing feasibility studies for many more years, without making larger-scale attempts to increase numbers of coho in mid-Columbia tributaries, simply adds costs to the region's efforts to restore coho with no benefit in terms of harvest or ecological diversity. In addition, the small-scale studies of interactions done so far demonstrated that effects (either beneficial or adverse) are unlikely to be observed until a significant number of juvenile and adult coho are introduced into the regional ecosystem.

The extensive monitoring program proposed (see Section 4.3.3 for a summary and Chapter 7 for details) is necessary in order to:

- 1) help proponents to respond to potential species interactions;
- 2) determine if or when goals of each phase have been achieved;
- 3) guide any necessary adaptations in program management or direction;
- 4) provide scientific documentation of the results of this innovative program.

The expense of the monitoring program is offset by the relatively low capital costs achieved by focusing on use of existing facilities for the first two phases of the program; and by proposing primarily low-cost new facilities in later phases, if warranted.

4.3 Proposed Program

4.3.1 Phased Approach

The proposed coho reintroduction plan builds on the existing Mid-Columbia Coho Reintroduction Feasibility Study. It is designed to achieve coho restoration goals in mid-Columbia tributaries as identified in the Tribal Restoration Plan (*Wy-Kan-Ush-Mi Wa-Kish-Wit*) and in the Wenatchee and Methow subbasin plans. We present a phased approach which incorporates the development of a mid-Columbia hatchery broodstock, naturalization through local adaptation to tributaries in the Wenatchee and Methow subbasins, and habitat restoration that benefits coho reintroduction as well as ESA-listed spring chinook, steelhead and bull trout.

The conceptual restoration plan for coho salmon in the Wenatchee and Methow subbasins includes five distinct phases. The program is designed to be discontinued after five generations of supplementation unless it can be clearly demonstrated that continued supplementation is needed to prevent extirpation from once again occurring.

- Habitat Improvement Phase (HIP) is expected to last 10-15 years and seeks to coordinate and implement the habitat improvement schedule developed for the UCSRB. Results of this schedule are expected to improve productivity and capacity of coho salmon, spring chinook salmon, bull trout, and steelhead.
- **Broodstock Development Phase 1 (BDP1)** is designed to develop a mid-Columbia broodstock from lower Columbia River coho, so that they become increasingly adapted to the longer migration to mid-Columbia tributaries. BDP1 focuses on eliminating reliance on lower Columbia stocks and transitioning to a local broodstock. This phase

has been completed in the Wenatchee subbasin. During FY 2007-2009 the Methow subbasin will operate in this phase. The expected duration of BDP1 in the Methow is three years.

- **Broodstock Development Phase 2 (BDP2)** is designed to encourage local adaptation of the broodstock by moving broodstock capture sites further upstream where stamina and run-timing constraints of lower Columbia brood coho may be reaching their limits (Murdoch et al. 2004). During FY2007-2010 the Wenatchee subbasin will operate in this phase. The expected duration of BDP2 is four years for the Wenatchee subbasin and three years for the Methow.
- **Natural Production Phases** focus on decreasing domestication selection and increasing fitness in the natural environment. Hatchery coho will be introduced to habitat areas predicted by EDT to be the most successful for coho. Also, hatchery and natural broodstock compositions will be managed to increase the proportion of natural influence (PNI⁶) in the population, with the goal of having a PNI value 0.5—that is, the natural environment must have a greater influence on the population than the hatchery environment. The natural production phases are described below:
 - o Natural Production Implementation Phase (NPIP) represents initial releases into most habitat areas and will proceed for one generation. The NPIP seeks to begin the local adaptation⁷ process by releasing enough hatchery fish in the natural environment to result in a spawning aggregate in each tributary, of sufficient size that natural selection can act upon the population and enough first generation natural origin adults will begin to return so that they can be incorporated into the broodstock as the Natural Production phases continue. The Wenatchee and Methow subbasins are expected to begin this phase in FY2011 and FY2012 respectively. The duration of this phase will be one generation (3 years).
 - o Natural Production Support Phase (Support Phase) will emphasize further local adaptation and naturalization. We will do this through an initial 30% reduction in release numbers, with a goal to increase the proportion of natural origin fish in the broodstock (pNOB) to 35% and to limit the proportion of hatchery origin fish (pHOS) on the spawning grounds to 75%. As we reach this initial goal, we will continue to reduce the hatchery program size, increase the pNOB and decrease the pHOS to the point that we are able to reach a PNI value greater than 0.50 (pNOB = 80%, pHOS < 65%). A PNI > 0.5 is predicted to result in increased natural fitness and associate survival rates for the population (L. Mobrand pers. comm.). The Wenatchee and Methow subbasins are expect to begin this phase in FY2014 and FY2015, respectively. The expected duration of the Support Phase is four generations (12 years).

⁶ If pNOB is the percent natural-origin fish in the hatchery broodstock and pHOS is the percent hatchery origin fish among natural spawners, then PNI= pNOB/(pNOB+pHOS).

⁷ We use the term "local adaptation" to refer to the process of naturalization: addressing the loss of fitness that occurs with hatchery stocks by emphasizing selection in the natural environment so that the population becomes adapted to habitats within each subbasin and ultimately achieves PNI > 0.5. "Local adaptation" is distinguished from "broodstock development" which selects for coho that can return to the Wenatchee and Methow rivers but does not address loss of fitness and adaptation to the natural environment.

Key goals and management strategies for the five phases in each subbasin are summarized in Tables 4-1 and 4-2.

Table 4-1. Wenatchee subbasin program summary

	BDP1	BDP2	Natural Production Implementation	Natural Production Support	Fully Restored Population
Management Goal	-Eliminate transfers of Lower Columbia River Brood. -Broodstock collection = 1,312 (25% past Tumwater)	-"Fine tune" broodstock so that returning coho can reach key habitat within the subbasinsBroodstock collection = 1,312 (50% past Tumwater).	-Initiate natural production in key habitat areasNOR escapement >600	-Develop locally adapted fully integrated stock. -NOR escapement >900	-Self-sustaining, naturally reproducing population is established. -NOR escapement >1,500. -Terminal and mainstem harvest in most years.
Management Strategy	-Primary release site in Icicle CreekBroodstock collected at Dryden Dam and LNFH.	-Release 50% of smolts above Tumwater Dam, 50% in Icicle CreekBroodstock collected at Tumwater Dam.	-Release Wenatchee broodstock in areas predicted by EDT to be most productive for coho in sufficient numbers to seed habitat and begin local adaptationImplement matrix schedule for harvest and broodstock management. pNOB = 10% pHOS = 90%	-Further local adaptation process and reduce domestication selectionConvert to integrated hatchery program and move towards PNI >0.5Implement matrix schedule for harvest and broodstock management. pNOB = 80% pHOS = 60%	-Harvest according to the matrix scheduleImplement hatchery supplementation as needed to prevent extirpation and achieve harvest goals, subject to condition that PNI>0.5.
Coordinated Habitat Projects	-UCSRB habitat initiative schedule is begun through HCP, SRFB, BPA, PCSRF funds.	-Continue UCRSB habitat initiative schedule through HCP, SRFB, BPA, PCSRF funds.	-Continue UCSRB habitat initiative schedule through HCP, SRFB, BPA, PCSRF fundsHydro-system survival is improved.	-UCSRB habitat initiative schedule is fully implemented.	-USSRB habitat initiative schedule is fully implementedHydro-system survival specified in the BiOP is achieved.

Table 4-2. Methow subbasin program summary

Table 4-2. We	BDP1	program summ BDP2	Natural	Natural	Fully
		DDI 2	Production Implementation	Production Support	Restored Population
Management Goal	-Eliminate transfers of Lower Columbia River Brood. -Broodstock collection = 656.	-Encourage broodstock adaptation so that returning coho can reach key habitat within the subbasins. -Broodstock collection = 1,312.	-Initiate natural production in key habitat areasNOR Escapement >600.	-Develop locally adapted, fully integrated stock. -NOR Escapement >900.	Self-sustaining naturally reproducing population is establishedNOR Escapement >1500Terminal and mainstem harvest in most years.
Management Strategy	-Primary release site(s) at WNFH and Wells FHPrimary broodstock collection site is Wells Dam	-Primary release site(s) at WNFH and Wells FHPrimary collection site(s) at WNFH and tributary weirs.	-Release Methow broodstock in areas predicted by EDT to be most productive for coho in sufficient numbers to seed habitat and begin local adaptationImplement matrix schedule for harvest and broodstock management. pNOB = 10% pHOS = 90%	-Further the local adaptation process and reduce domestication selectionConvert to integrated hatchery program and move towards PNI >0.5Implement matrix schedule for harvest and broodstock management. pNOB = 80% pHOS = 60%	-Harvest according the matrix scheduleImplement hatchery supplementation as needed to prevent extirpation and achieve harvest goals, subject to condition that PNI>0.5.
Coordinated Habitat Projects	-UCRSB habitat initiative schedule is begun through HCP, SRFB, BPA, PCSRF funds	-UCRSB habitat initiative schedule is continued through HCP, SRFB, BPA, PCSRF funds	- UCRSB habitat initiative schedule is continued through HCP, SRFB, BPA, PCSRF funds. Hydro-system survival is improved.	-UCRSB habitat initiative schedule is fully implemented.	USRSB habitat initiative schedule is fully implemented. Hydro-system survival specified in the BiOP is achieved.

Table 4-3 shows release plan numbers for each phase in both the Wenatchee and Methow subbasins

Table 4-3. Proposed smolt release numbers

(*smolts released*/1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Wenatchee																					
Broodstock Dev																					
Phase I																					
Phase II	1.00	1.00	1.00	1.00	1.00																
Natural Production																					
Implementation						1.16	1.16	1.16													
Support Phase I									0.81	0.81	0.81	0.81	0.81	0.81							
Support Phase II															0.40	0.40	0.40	0.40	0.40	0.40	
Methow																					
Broodstock Dev																					
Phase I	0.50	0.50	0.50																		
Phase II				0.50	0.50	0.50															
Natural Production																					
Implementation							1.00	1.00	1.00												
Support Phase I										0.70	0.70	0.70	0.70	0.70	0.70						
Support Phase II																0.35	0.35	0.35	0.35	0.35	0.3
TOTAL	1.50	1.50	1.50	1.50	1.50	1.66	2.16	2.16	1.81	1.51	1.51	1.51	1.51	1.51	1.10	0.75	0.75	0.75	0.75	0.75	0.3

4.3.2 Proposed Facilities – Overview

A progressive approach to the design of the MCCRP has been taken. Input from experienced Yakama Nation biologists, reviews of the recent scientific literature, and discussions with regional experts have been used to assemble a program that is and will continue to make use of the latest salmon reintroduction methodology. Important publications include Hatchery Reform: Principles and Recommendations of the Hatchery Scientific Review Group (Mobrand et al. 2004). Many of the conclusions reached by the HSRG about the future of hatcheries and how they should be operated are being implemented by the MCCRP. These include using hatcheries as part of an "integrated strategy" to meet harvest and conservation goals, operating hatcheries "with consideration of the potential for genetic and ecological interactions with natural stocks," and developing plans with well defined goals and informed feedback.

The project design and operation are also consistent with features of "landscape hatcheries" as described by Williams et al. (2003). MCCRP practices that conform to the recommended principles of ecosystem-based hatchery programs are the capture of locally returning brood that are genetically representative of the local stock; production of fish using wild characteristics as a guideline; rearing on natural water temperatures at low densities; system flexibility (responsiveness to the principles of adaptive management); decentralized, small-scale release sites; and the monitoring and evaluation of results.

Broodstock Development Phases

Fish produced for the broodstock development phases would be captured at existing adult traps, produced from existing hatcheries, and released from acclimation sites that do not require new

rearing unit construction. However, modifications to these existing facilities may be necessary in order to meet project goals (see Chapter 6).

Figure 4-1 shows the existing sites of major fish culture activities.

• Broodstock capture:

Wenatchee subbasin: traps on the Wenatchee River will include Leavenworth NFH, and Tumwater and Dryden Dams.

Methow subbasin: trapping facilities will include Wells FH, Winthrop NFH, and Wells Dam east/west ladders.

- Broodstock holding and early incubation: Entiat and Winthrop NFHs.
- Rearing to pre-smolt size: Cascade FH, Willard and Winthrop NFHs.
- Acclimation:

Wenatchee: Rohlfing, Coulter, Butcher, and Beaver ponds and the Leavenworth NFH on Icicle Creek.

Methow: Winthrop and Wells hatcheries.

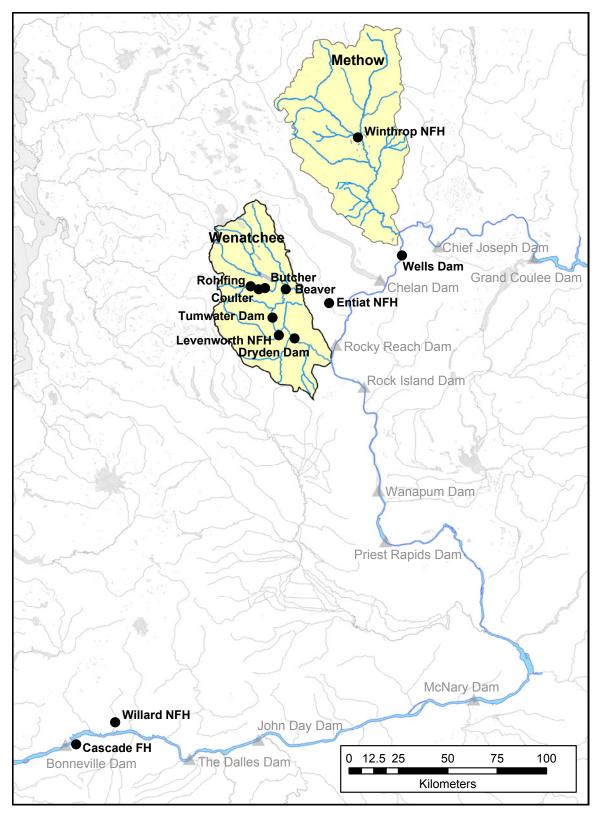


Figure 4-1. Sites of Fish Culture Activities and Existing Facilities

Natural Production Implementation Phases

Beginning with the NPIP, the plan proposes to continue rearing most program fish at existing hatcheries, with constructed habitats in the Methow producing 15% of the total. Acclimation is planned to occur in a combination of existing and new sites. The release sites target EDT-predicted coho spawning and rearing habitat. The multi-function sites in the Methow basin would be used as both rearing and release sites. One conventional acclimation site is planned on the White River in the Wenatchee watershed. The remainder of the sites are existing pools and small, constructed ponds. Table 4-4 summarizes those facilities and Figures 4-2 and 4-3 show their locations. Chapter 6 and the C Appendices describe the facilities in more detail.

Table 4-4. Proposed program facilities, existing and new

Facility	Wenatchee Subbasin F	acilities	Methow Subbas	in Facilities
Туре	Site	Status	Site	Status
Brood capture (primary sites)	Dryden	Existing	Wells Dam	Existing
	Tumwater	Existing	Winthrop NFH	Existing
	Tributary weirs	Existing and new	Tributary weirs	Existing
			Foghorn	Existing
Rearing	Cascade	Existing	Cascade	Existing
	Willard	Existing	Winthrop	Existing
Multi-Function	Dryden ¹	New	Eightmile ²	New
			Heath Ranch ²	New
Acclimation	Icicle/ LNFH	Existing	Methow/Winthrop	Existing
	Nason/Coulter/Roaring	Existing	Chewuch/Ramsey	Existing
	Nason/ Rohlfing	Existing	Twisp/ Poorman	Existing
	Beaver/Beaver	Existing	Twisp/ Lincoln	New
	White/Tall Timber	New	Wolf/Biddle	Existing
	Chiwawa/Clear	Existing	Methow/Hancock	Existing
	Chiwawa Chikamin/Minnow	New	Methow/Goat Wall	New
	Chiwawa/Chiwawa	New		
	Little Wen./Two Rivers	Existing		

¹Dryden is an adult holding and incubation facility only.

²Eightmile and Heath Ranch are multi-function sites where both rearing and acclimation occur.

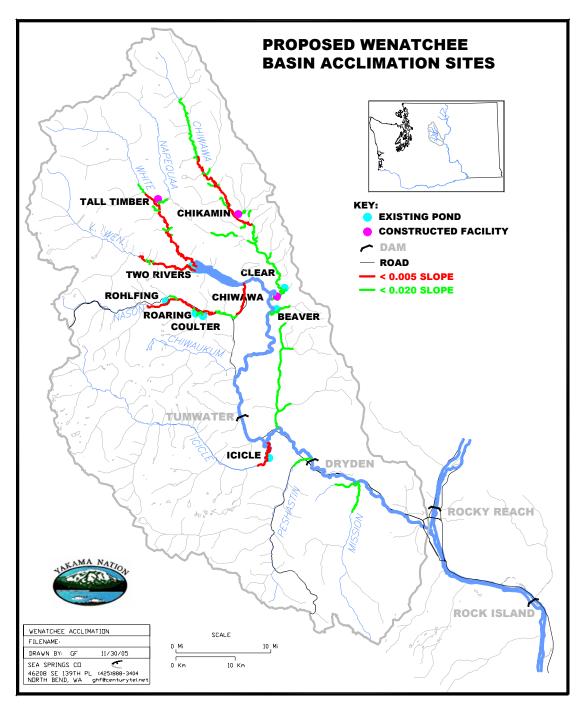


Figure 4-2. Wenatchee Subbasin Proposed Acclimation Sites

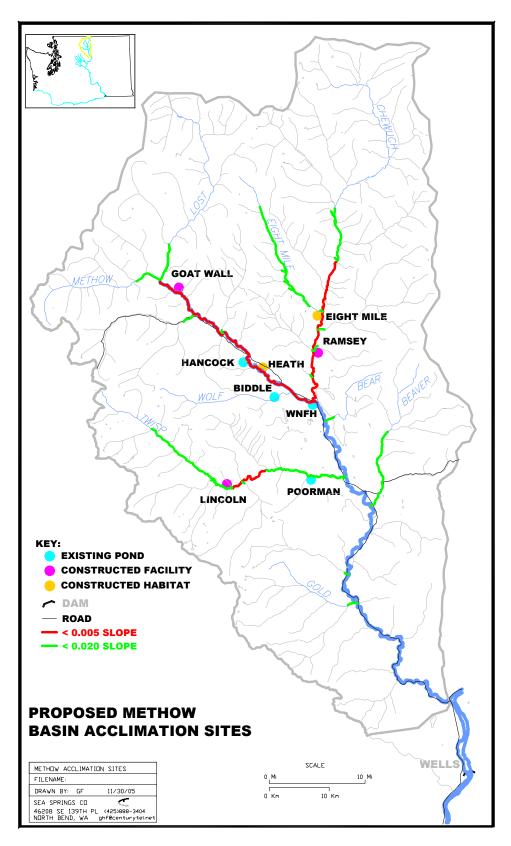


Figure 4-3. Methow Subbasin Proposed Acclimation Sites

The scheduling of program fish culture activities is shown in Table 4-5. The timing of egg and fish transfer between facility components is guided by this schedule. Adults are moved from capture sites to holding facilities in the fall for ripening and spawning. Green egg incubation occurs at or near these holding facilities. Eyed eggs are moved to hatcheries in mid-winter for final incubation and early rearing. After marking at the end of June, some of the hatchery production can be moved to constructed habitats (Section 6.2.3) or to hatchery grow-out ponds. In early to late winter, pre-smolts are moved to the remaining final acclimation/release sites.

Table 4-5. Coho production timetable

	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr
BROOD AND EGGS																				
Adult Holding																				
Spawning																				
Green Egg Inc.																				
Eyed Egg Inc.																				
HATCHERY REARING																				
Raceway/Tanks																				
Grow Out																				
ACCLIMATION																				
Constructed Hab.																				
Overwinter																				
Short Term																				

4.3.3 Summary of Proposed Monitoring and Evaluation Plan

The success of the proposed coho reintroduction plan depends on extensive monitoring and evaluation to answer key questions such as which acclimation sites are most successfully producing returning fish; when the program in each basin can move into a new phase; whether supplementation will be appropriate; and whether naturally produced coho are adversely affecting listed and sensitive species. Table 4-6 summarizes the M&E plan; details are provided in Chapter 7.

Table 4-6. Summary of M&E activities

M&E Activity	Indicator	Strategy	Restoration Phases	Coordination with other programs
Release-to- McNary survival	Project Performance	PIT tags	BDP1, BDP2, NPIP, NPSP ¹	No
In-pond survival	Project Performance	PIT tags, predation control	BDP1, BDP2, NPIP, NPSP ¹	No
Pre-release fish condition	Project Performance	Physical examination	BDP1, BDP2, NPIP, NPSP	No
Volitional release run-timing and tributary residence	Project Performance / Species Interaction	PIT Tags, smolt trapping	BDP1, BDP2, NPIP, NPSP ¹	Yes: Integrated Status & Effective- ness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
Spawning escapement and distribution	Project Performance	Redd counts Carcass recovery Radio-telemetry CWT	BDP1, BDP2, NPIP, NPSP	No
Natural smolt production	Project Performance	Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP ²	Yes: Integrated Status & Effective- ness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
Egg-to-emigrant survival	Project Performance	Smolt trapping Redd counts CWT	BDP1, BDP2, NPIP, NPSP ²	Yes: Integrated Status & Effect- iveness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs

M&E Activity	Indicator	Strategy	Restoration Phases	Coordination with other programs
Adult-to-adult survival	Project Performance	Adult trapping Redd counts Carcass recovery CWT	BDP1, BDP2, NPIP, NPSP	No
Adult-to-adult productivity	Project Performance	Adult trapping Carcass recovery CWT Scale analysis	NPIP, NPS	No
Harvest rates	Project Performance	CWT Scale analysis Database queries	BDP1, BDP2, NPIP, NPSP	Yes: Coordinated with harvest management agencies
NTTOC – Size structure	Species Interactions	Smolt trapping Electro-fishing	BDP1, BDP2, NPIP, NPSP ³	Yes: Integrated Status & Effective- ness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
NTTOC – Abundance and survival	Species Interactions / Status of NTTOC	Smolt trapping Underwater observation Electro-fishing	BDP1, BDP2, NPIP, NPSP ³	Yes: Integrated Status & Effective- ness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
NTTOC – Distribution	Species Interactions / Status of NTTOC	Redd counts Underwater observation Electro-fishing	BDP1, BDP2, NPIP, NPSP ³	Yes: Integrated Status & Effective- ness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
Competition	Species Interactions / Mechanisms of Interaction	Underwater observation Enclosures Size and growth	NPIP	No

M&E Activity	Indicator	Strategy	Restoration Phases	Coordination with other programs
Predation by naturally produced coho on spring chinook fry	Species Interactions / Mechanisms of Interaction	Smolt trapping Emergence and emigration timing	NPIP	Yes: Integrated Status & Effective- ness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
Morphometrics and life history traits	Genetic Adaptability	Adult trapping Redd counts Carcass recovery Smolt trapping CWT	BDP1, BDP2, NPIP, NPSP	Yes: Integrated Status & Effect- iveness Monitoring Program (BPA project #2003-017- 00); CCPUD/ DCPUD HCP Hatchery Programs
Genetic monitoring	Genetic Adaptability	Genetic sampling CWT	BDP1, BDP2, NPIP, NPSP	No
Contemporaneous sperm cryo-preservation	Genetic Adaptability	Cryo-preserva- tion and use of previously preserved milt	BDP1, BDP2, NPIP, NPSP ⁴	No

¹ PIT tags Will be used during NPSP if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted.

² Natural smolt production and egg-to-emigrant survival estimates will be specific to release tributaries during NPIP and NPSP, and basin-wide during BDP1 and BDP2.

³ Baseline NTTOC monitoring during BDP1 & BDP2, effect monitoring during NPIP &NPSP.

⁴ Milt for cryo-preservation will be collected during BDP1 (initially, milt was collected during feasibility), stored throughout BDP2 and used for evaluation during NPIP or NPSP.

4.3.4 Program Cost Summary

This section summarizes estimated costs for all the program elements; Chapter 8 provides the details. Costs are based on a fish release plan that is expected to last until 2026, as shown in Table 4-7.

Table 4-7. Program schedule

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Wenatchee																					
Broodstock Dev																					
Natural Production																					
Methow																					
Broodstock Dev																					
Natural Production																					

Estimates of the capital and operating costs cover the project's lifetime. Capital cost estimates are shown in Table 4-8 and include program planning; preliminary and final designs; project-level (such as NEPA and ESA) evaluations; facility development permits; land purchase; construction; and capital equipment. To minimize capital costs, the proposed facility plan for the Mid-Columbia Coho Restoration project makes extensive use of existing facilities—brood capture, rearing, and acclimation—in the region.

Table 4-8. Total MCCRP capital costs

Planning and Design	\$1,040,975
Permits	\$875,355
Capital Equipment	\$1,280,130
Multi-Function Facilities	\$3,473,294
Acclimation Facilities	\$3,252,439
TOTAL	\$9,922,193

Operating expenses include the operation and maintenance of these facilities, as well as the monitoring and evaluation program, and general and administrative project costs. Operating costs will change over time. Expenses during years when release numbers and operating costs are at their maximum are estimated to be:

Table 4-9. Peak annual operating expenses (2012)

	J
Operation and Maintenance	\$2,250,710
Monitoring and Evaluation	\$1,298,425
Tagging	\$653,417
General and Administrative	\$428,620
SUBTOTAL	\$4,631,172
Cost Share	\$1,179,800
TOTAL	\$3,451,372

The proposed program currently shares rearing costs with National Oceanic and Atmospheric Administration (NOAA) through the Mitchell Act and monitoring and evaluation costs with WDFW and the region's Public Utility Districts (PUDs). Additional funding support may be available in the future through these agencies and others in the region.

4.3.5 Contingency Plans and Decision Processes

1. If BDP1 goals are not achieved within 3 generations:

- a. Evaluate cause for failure to meet BDP1 goals. Possible causes include but are not limited to: poor trap efficiency, lower than expected SARs (due to migratory or ocean conditions), and lower than expected egg-to-smolt survival (in hatchery).
- b. Determine if the cause of failure to achieve goals can be ameliorated.
- c. Implement course of action and re-evaluate after one generation. If course of action appears successful, continue until BDP1 goals are achieved or for two generations.
- d. If no corrective action can be made and the cause is determined to be the result of out-of-basin effects, repeat BDP1.
- e. If no corrective action can be made and the cause is not the result of out-of-basin effects, consider a harvest augmentation program.

2. If BDP2 goals are not achieved within 4 generations:

- a. Evaluate the cause for failure to achieve BDP2 goals. Possible causes include, but are not limited to: poor trap efficiency, lower than expected SARs (due to migratory or ocean conditions), lower than expected egg-to-smolt survival (in hatchery), the local adaptation process does not proceed as quickly as expected, or we made incorrect assumptions regarding coho habitat and life history in mid-Columbia tributaries.
- b. Determine if the cause of failure to meet goals can be ameliorated.

- c. Implement course of action. If the local broodstock is not adapting as quickly as expected, the course of action may include repeating BDP1.
- d. If no corrective action can be made and the cause is determined to be due to out-of-basin effects, repeat BDP2.
- e. If no corrective action can be made and the cause is not the result of out-of-basin effects, consider a harvest augmentation program.

3. Natural Production Phases Adaptive Management Process:

The natural production phases are designed to result in a fully integrated program, while decreasing domestication selection and increasing local adaptation in both the broodstock and the natural spawning population. To achieve this, we used the AHA model to address the loss of fitness associated with hatchery programs for five generations of broodstock management. The natural production phases are not measured against a success/failure scenario; rather, they represent an evaluation and decision process—an adaptive management process.

- a. After one generation of the Natural Production Implementation Phase, release numbers will be reduced by 30%. The purpose of the Natural Production Implementation Phase is to cycle sufficient coho eggs through the natural environment to begin the local adaptation and naturalization process.
- b. For the Support Phase, release numbers initially will be reduced by 30% (from Implementation Phase release numbers), with an initial target of 35% pNOB and 75% pHOS. (Note: AHA does not predict that pHOS objectives will be met until release numbers are further reduced.) If initial pNOB targets are not met within two generations, the program will be closely evaluated and adjusted depending upon the reason initial targets have not been reached. Possible reasons include but are not limited to 1) inadequate trapping facilities or protocols; or 2) lower than expected productivity, migratory survival, or marine survival.
 - i. If we determine that sufficient natural-origin brood are returning to the basin but we are unable to incorporate sufficient numbers into the broodstock, primary trap locations, operation schedules, or trap modifications may be required.
 - ii. If insufficient numbers of natural-origin coho are returning to the basin, then either productivity, migratory or marine survival are lower than expected and modeled. If the cause is lower than expected productivity, habitat improvements may need to better target key areas for coho production, the habitat improvement schedule may need to be accelerated, or the coho are not adapting as quickly as expected. Under these scenarios we will continue with the current release and broodstock capture strategy or consider reducing release numbers to aid in reaching initial pNOB targets and accelerate the local adaptation process.
 - iii. After initial pNOB targets have been achieved for one generation (3 years) and the habitat improvement schedule is proceeding as anticipated, release numbers will be reduced by 50%, the pNOB target will be increased to 80% and the pHOS target will become 60%. A similar decision process

- will be repeated as described in "i" above. When final pNOB targets have consistently been achieved for one generation, the local adaptation process should have progressed sufficiently that the proposed BPA-funded program could be discontinued.
- iv. Supplementation may be required in some years, and local adaptation could be protected by releasing moderate numbers of coho smolts to hedge against catastrophic events. All populations have lows and highs. In the low years, supplementation might be needed as an insurance policy against a second extirpation. Alternatively, a small supplementation program may be needed at the end of the proposed 20-year program (5 generations after beginning the NP phases). For example, 150,000 coho smolts could be produced at LNFH for a number of years (maybe 10) until we are sure the naturally spawning populations can survive for the long term. In both cases, the fish would come from the naturally spawning population, and in both cases, the program could be funded under the PUDs' compensation program, not by BPA.

4.3.6 Why the Program is Expected to Succeed

The basic premise of the Mid-Columbia Coho Restoration Program is that non-local, domesticated hatchery stocks can be used to develop self-sustaining, naturally reproducing populations in targeted watersheds. Results to date have demonstrated that the concept is viable if properly implemented (Murdoch et al. 2004). The program presents a unique opportunity to develop methods for, and measure rates of, the conversion of hatchery stocks into naturally reproductive and viable populations in new habitats. The AHA model would be used to address the loss of fitness common with hatchery programs by reducing domestication selection and emphasizing local adaptation. This new line of research complements the past two decades of fishery genetics research, which has emphasized the risks of artificial propagation to natural populations, by exploring the potential for using abundant hatchery genetic resources to restore extirpated or demographically vulnerable populations. This is particularly important as regional fishery managers and funding entities consider the role of artificial propagation in the recovery of ESA-listed and non-listed populations and extirpated salmonids.

Previous efforts to transplant salmon populations to new environments show varying outcomes. There are many examples of unsuccessful attempts to develop new populations from both hatchery and natural transplants. Quinn (2005) discusses examples which include serious efforts to introduce: 1) an even-year pink run in Puget Sound, 2) chinook in Chile, 3) pink salmon on the East Coast, and 4) sockeye in Upper Adams Lake, B.C. He discusses these failures as examples of "the importance of local adaptation to fitness."

Further evidence of the role of local adaptation comes from a coho study done at Big Creek Hatchery in Oregon. Unfertilized eggs and milt were brought to this hatchery from many hatchery locations and reared to smolt size for release. It was found that the distance between the release site and the river of origin had a large impact on survival rates (Reisenbichler 1988). Coho from within the same drainage showed similar and higher survival rates than those moved large distances.

A number of successful introductions demonstrate the potential effectiveness of transplanting donor stocks over long distances to develop new salmonid populations. Examples of successful transplants of anadromous fishes outside the species' range include:

- Pink, coho, chinook salmon, and steelhead are now self-sustaining in all of the five Great Lakes as a result of hatchery plants in 1956 (Quinn 2005).
- Anadromous populations of chinook salmon were established in New Zealand from releases to a single river system (the Waitaki) between 1901 and 1907 (McDowall 1994). Spawning chinook were noted in the Hakataramea River within a few years and within 10 years had distributed to other large glacier-fed rivers on the east coast of the South Island where spawning presently occurs (Kinnison et al. 2001). Due to local adaptation, the New Zealand chinook populations now phenotypically differ in morphometric and reproductive traits (Kinnison et al. 1998a, 1998b; Kinnison et al. 2001).
- Sockeye transplanted from Baker Lake (Washington) established a self-sustaining population in Lake Washington and Lake Sammamish after the indigenous population was extirpated by the construction of the Montlake Cut in 1917.
- Construction of a dam near the mouth of the Methow in 1915 extirpated the native spring chinook stock. The Winthrop NFH helped re-establish the run with chinook captured from the trap at Rock Island Dam after removal of the dam (Brannon et al. 2004).

These successes were probably a result of the transplanted populations having enough of the adaptive traits needed to be viable within the introduced environment. Evaluation of these successes demonstrates that:

- 1) introduced hatchery stocks have the capacity to quickly adapt to local conditions (Quinn 2005; Brannon et al. 2004; Hendry 2001), and
- 2) much remains to be learned about the critical elements of successful reintroductions.

The most relevant past attempts at coho reintroduction are in the mid-Columbia region. Mullan (1984) states that despite hatchery releases at Leavenworth, Entiat, and Winthrop National Fish Hatcheries from 1942 to 1975, "there is no evidence to indicate development of a self-sustaining population of coho salmon above threshold levels recorded in the 1930s." The failure to reestablish natural coho runs through these hatchery releases was "to have been primarily related to necessary reliance, because of severe depletion of upper river stock, upon short-run, latespawning lower river stocks lacking genetic suitability."

In earlier attempts at coho restoration, there were few aquacultural or genetic protocols to prepare the stock for local habitat conditions. The mid-Columbia coho program is expected to succeed for the following reasons:

This program emphasizes accelerating local adaptation of donor stocks.

• The phased approach described in Chapter 4 moves broodstock capture and smolt release locations upstream as adaptive criteria, such as tissue lipid levels, skin color, run timing, maturation timing and condition factor increase in the returning adults. Naturalization is encouraged as an evolutionary process.

- Natural-origin fish will be preferentially selected for broodstock to maximize local adaptation and minimize further domestication. The target proportion of natural-origin fish in the broodstock increases and release numbers decrease as the program progresses.
- Improved fish culture techniques (rearing at low densities, acclimation in natural conditions, improved feed, following natural growth profiles) have been shown to increase adult return rates and provide a higher likelihood that enough adults will return to satisfy local broodstock development needs. The higher adult return rates also expand the genetic pool from which local, heritable traits will develop.
- Acclimation and release locations are proposed in areas that have high-quality coho habitat.
- Coordinated efforts to improve habitat conditions for coho salmon and other salmonids should result in increased productivity and survival of naturally produced fish.

This program is taking advantage of improved post-release survival conditions.

- Tributary outmigration survival has increased due to improvements in irrigation screening systems.
- Mainstem Columbia hydro project operations now include water management and smolt protection systems that improve smolt survival.
- Mainstem predation control is provided by programs such as the northern pikeminnow sportfish reward program.
- When the draft Upper Columbia Recovery Plan (UCSRB 2005) for listed salmonids is adopted and implemented, measures to improve survival will benefit coho as well.
- HCP required survival criteria and tributary habitat improvements will be implemented.
- Evidence that this approach is working comes from data collected during the feasibility phases of the mid-Columbia and Yakima River coho reintroduction programs. An important measure of the effect of local adaptation is smolt-to-adult return rate. The results presented in Section 3.1 show that this rate is increasing rapidly for all coho programs above McNary Dam (mid-Columbia, Umatilla River and Yakima River) after implementation of the fish culture techniques described above.

4.4 Program Risks

Program risks generally fall into three categories:

- 1) species interaction risks,
- 2) facility development risks, and
- 3) operations risks.

During feasibility studies, the program studied interaction risks extensively. Results are summarized in Chapter 3. While we believe the proposed program poses little risk to other species, we recognize that some uncertainty remains and have proposed studies in the monitoring and evaluation plan to determine changes in status to other fish species and whether the change is caused by coho reintroduction (see Section 7.2). Interaction risks also will be reviewed during

NEPA and ESA analyses that will be done as part of the Step 2 process, but previous NEPA and ESA analyses for this project have shown little impact or have resulted in modifications to the program to accommodate concerns.

Risks of developing the proposed new facilities have not been comprehensively assessed, although preliminary issues and potential problems have been identified. The potential exists for impacts to natural resources such as wetlands, floodplains, non-aquatic listed and sensitive species, water quality and quantity, and to property owners and nearby residents. Chapter 6 describes preliminary development risks for each proposed new site. The detailed evaluation of site development impacts will be done during the NEPA evaluation that is part of the Step 2 process. Development risks are reduced by selecting alternative sites for each proposed facility component.

Operations risks include effects on listed and sensitive species of smolt and adult trapping, electro-shocking, and other M&E activities. Effects of any proposed changes in operation of existing traps, or locations of M&E activities, will be evaluated in NEPA and ESA analyses and will be subject to conditions set during those processes. Operational risks are reduced by considering potential impacts during site location selection and facility design.

4.5 Program Benefits

Coho reintroduction is an important part of a regional, integrated, ecological recovery strategy. Cultural, socio-economic, and ecological benefits are expected to result from the return of this species to areas where it once occurred in abundance.

Salmon are a part of the spiritual and cultural identity of the four Columbia River treaty tribes. They also play an important role in the economic well being of tribal members. Recovery of coho salmon to the Yakama Nation's "usual and accustomed" fishing places helps support regional tribal objectives.

The commercial value of Columbia Basin tribal, commercial, and recreational fisheries is estimated by the IAEB (2005) as contributing "about \$142 million total personal income annually to communities on the West Coast." Coho salmon returning to Mid-Columbia watersheds will add to this value.

Marine nutrients deposited in the form of coho carcasses will improve stream rearing conditions for other species (Quinn 2005), including those that are ESA-listed. Juvenile steelhead, for example, congregate in areas where salmon carcasses are deposited and they show a dramatic increase in condition factor (Bilby et al. 1998). Coho salmon may be a particularly important link in nutrient cycling processes. Coho salmon spawn high in the watershed at the onset of winter, delivering nutrients to the uppermost reaches where all species downstream will benefit (Vannote et al. 1980). During winter, reduced primary production may limit the standing crop of invertebrates. The addition of carcasses at the onset of winter may provide an increased food base (Pearsons and Hopley 1999) and improve over-winter survival for all species. The Wenatchee Subbasin Plan (page 27) recognizes that "Restoration of individual populations may not be possible without restoration of other fish and wildlife populations with which they coevolved." (NPCC 2004a).

The presence of both naturally produced and hatchery coho may increase prey densities, potentially reducing losses of ESA-listed species from predation. Coho eggs, fry, and smolts

(natural and hatchery) will increase the availability of prey, providing increased food supply for aquatic species including steelhead and bull trout (Pearsons and Hopley 1999). Loss of prey likely has contributed to the decline in bull trout populations (Ratliff et al. 1996).

Ecological benefits of coho restoration could extend beyond the aquatic community to other ESA-listed species, including the bald eagle and grizzly bear. Salmon are an important feed resource for these species. Bald eagles, over-wintering in the Wenatchee River, have been observed feeding on coho carcasses on Icicle Creek (C. Kamphaus, YN, pers. comm.). Riparian vegetation will also benefit from the nutrients derived from coho carcasses (Quinn 2005; Cederholm et al. 1999). For these reasons, salmon are recognized as a "keystone" species in vertebrate communities (Quinn 2005, Cederholm et al. 1999, Willson and Halupka 1995).

Other listed fish species will indirectly benefit from the presence of this missing native species. The justification for developing regional habitat conservation measures protecting all fish species will be strengthened. For example, restoring hydraulic functionality to currently isolated side channels will be an important habitat improvement for coho. Parts of these side channel habitats may also be used by spring chinook, steelhead, and bull trout.

Project purchase of riparian land for acclimation and constructed habitat will protect critical habitat for all species. Constructed habitat will benefit all species as a natural rearing environment after the termination of this project.

The opportunity to study the local adaptation process in detail is a significant benefit to regional fish managers and researchers. There is very little literature available that evaluates the time or techniques required to develop locally adapted stocks or the traits that would define naturalization. The MCCRP will collect information on phenotypic traits such as migration timing, spawn timing, adult size, adult sex ratios, fecundity rates, and tissue lipid concentration as a measure of stored energy reserves (Section 7.3). Together with genotype measurements, these traits will be compared with those in the originating hatchery stock to track the rate and direction of adaptation to natural habitats in the mid-Columbia tributaries. Juvenile and adult survival rates will be documented and compared with other stocks and species considered to be locally-adapted natural stocks. This line of investigation will have system-wide application by providing the region with important new information regarding the role of hatcheries and hatchery stocks in restoring salmonid populations to natural habitats in the Columbia Basin.

In the words of the Endangered Species Act (1973):

"various species of fish, wildlife, and plants in the United States have been rendered extinct as a consequence of economic growth and development untempered by adequate concern and conservation;...these species of fish, wildlife, and plants are of aesthetic, ecological, educational, historical, recreational, and scientific value to the Nation and its people."

Chapter 5. Program Details



- 5.1 Broodstock Development Phase 1
- 5.2 Broodstock Development Phase 2
- 5.3 Natural Production Phases
- 5.4 AHA Calculations
- 5.5 Habitat Improvement Phase

Chapter 5. Biological Program Details

5.1 Broodstock Development Phase 1

5.1.1 Wenatchee

This phase has been completed in the Wenatchee subbasin. For FY2007-2009, the project will proceed to the second phase.

5.1.2 Methow

During FY2007-2008 we expect to implement BDP1 in the Methow subbasin. During BDP1, we plan to release 500,000 smolts annually from the Methow River Basin. Source fish for initial release would be a combination of adult returns from the current releases of 250,000-300,000 smolts, Wenatchee River coho returns in excess of Wenatchee River broodstock development goals, and reprogrammed lower Columbia River coho, if necessary. During BDP1, 250,000-350,000 acclimated coho smolts would be released from the Winthrop NFH (WNFH). The remaining 150,000-250,000 smolts would be released from acclimation site(s) at Wells Dam Hatchery, or on the Methow, Twisp and /or Chewuch rivers.

Both Methow and Wenatchee returns will be used to comprise the entire mid-Columbia program, with each basin supplementing the other in years of basin-specific shortfalls. Should broodstock shortfalls occur in the future in *both* basins, the program will rely on coho returns to other above-McNary Dam locations to supplement its production needs. The intent is *not* to use lower river hatchery populations for future broodstock. In 2005, the YN developed a contingency plan with the Umatilla Tribe and ODFW to use adult coho returns to the Umatilla River if there were shortfalls in the mid-Columbia. This plan was not needed when the run to the Wenatchee and Methow was sufficient to meet full production needs in 2005, but can be used in future years if necessary.

During BDP1, Wells Dam would be the primary broodstock collection site, with supplemental trapping at the WNFH, the Chewuch/Twisp weirs, and possibly Wells FH. BDP1 will be considered successful when a mean trappable adult return of 632 coho adults (annual broodstock collection goal) in one 3-year period within 9 years is reached at Methow basin trapping facilities (Wells Dam, WNFH, and Chewuch/Twisp weirs). Successful completion of BDP1 will trigger the implementation of BDP2.

5.2 Broodstock Development Phase 2

5.2.1 Wenatchee

During BDP2 (FY2007-2010), we propose to release one million smolts annually from the Wenatchee River basin. Approximately 500,000 would be released above Tumwater Dam in Nason Creek, Chiwawa River, and Beaver Creek. The remaining 500,000 coho smolts would continue to be released from Icicle Creek to ensure that broodstock collection goals are met while transitioning to upper basin collection sites.

We would primarily trap broodstock at Tumwater Dam, with additional trapping at Nason Creek (a semi-permanent weir is at the 30% design phase under the umbrella of the Grant County PUD production program), Chiwawa River Weir, Dryden Dam and/or Icicle Creek. An emphasis on the use of upstream trapping sites will allow selection for coho which are able to navigate Tumwater Canyon and return to tributaries of the upper Wenatchee River. Coho smolts released from upper basin tributaries and Icicle Creek would be differentiated by the use of body tags (a CWT placed in the adipose fin). Body tagging will allow researchers to either pass or capture adult coho at Dryden Dam.

Broodstock Development Phase 2 will be successfully completed when we have a mean adult return to Wenatchee River traps of 1,312 adult coho for one 3-year period within 9 years, with a minimum of 50% of the broodstock collected at Tumwater Dam or other upper basin trapping sites. The requirement of 50% of broodstock collected at Tumwater Dam is based on the distribution of juvenile releases (50% above Tumwater Dam and 50% below Tumwater Dam). If we collect 50% of our broodstock at Tumwater Dam (or other upstream trapping sites) when 50% of the juveniles are released in upstream areas, it is assumed that we will be able to trap 100% of our broodstock from upstream returning stocks during the Natural Production Implementation Phase. Successful completion of BDP2 will trigger the start of the Natural Production Phases.

5.2.2 Methow

BDP2 is expected to begin in FY2009 and continue through FY2011. During BDP2, we propose to release 500,000 smolts annual from the Methow River basin. During BDP2, 250,000-350,000 acclimated coho smolts would be released from the Winthrop NFH. The remaining 150,000-250,000 smolts would be released from acclimation site(s) on the Methow, Twisp and /or Chewuch rivers.

During BDP2, broodstock collection efforts would shift emphasis to upstream trapping sites, to select coho which are able to return to the WNFH and to coho spawning habitat. Winthrop NFH and the Chewuch/Twisp weirs will become the focal broodstock trapping locations. During BDP2, release sites and numbers would remain the same as during BDP1. We expect a gradual transition to 100% collection in upstream locations. During this transition, we would continue to trap as needed at Wells Dam to ensure that broodstock goals are met.

BDP2 will be considered successful when a mean of 656 adult coho (broodstock collection goal for BDP2) are trapped at upstream trapping sites (WNFH and Chewuch Weir) for one 3-year period, with 1,312 adult coho (broodstock collection goal for Natural Production Implementation Phase) trappable at Wells Dam. Completion of BDP2 will trigger the Natural Production Phases.

5.3 Natural Production Phases

The natural production phases are anticipated to begin in FY2011 (Wenatchee subbasin). At the conclusion of BDP2 we expect to have hatchery broodstock which can successfully migrate back to the Wenatchee and Methow rivers. However, we recognize that the Wenatchee and Methow stocks will remain domesticated until they are locally adapted to habitats in the natural environment. The Natural Production Phases described below represent the proposed transition from a domesticated hatchery program to locally adapted naturally reproducing populations in the Wenatchee and Methow subbasins.

We view the habitat initiatives and schedule described in Section 2.4.4 as a key component to successful restoration of the naturally reproducing coho populations. With the combination of habitat improvements, which should result in increased productivity, and a supplementation program designed to maximize local adaptation while reducing domestication selection, the program is designed to have reached its self-sustaining goals and be terminated after five generations of supplementation.

5.3.1 Natural Production Implementation Phase

We expect to begin the Implementation Phase in FY 2011 in the Wenatchee and in FY 2012 in the Methow. The Implementation Phase is designed to begin the local adaptation and naturalization process by reintroducing coho in areas predicted by EDT to have the greatest chance of success: the Chiwawa River, White River, Little Wenatchee River, Upper Wenatchee River, and Nason Creek in the Wenatchee subbasin; and in the mid- and upper reaches of the Methow River, the Chewuch River, and the Twisp River in the Methow subbasin. The Implementation Phase seeks to initiate the local adaptation and naturalization process by releasing enough hatchery fish in the natural environment to result in a spawning aggregate in each tributary of sufficient size that natural selection can act upon the population; and with an adequate number of first-generation natural-origin adults to incorporate into the broodstock as the Natural Production phases continue (Tables 5-1 and 5-2). The Implementation Phase will last for one generation (three years).

During NPIP in the Wenatchee subbasin, broodstock capture will continue to focus on upper basin sites listed in BDP2. Wherever facilities exist, broodstock will be collected within the tributary of release. Facility operations and trap duration continue from BDP2; additional trapping sites include the Chiwawa and White River adult weirs, though the latter has yet to be built by Grant PUD for the White River spring chinook recovery program.

Mid-Columbia Coho Restoration Program Master Plan

⁸ We use the term "local adaptation" to refer to the process of naturalization: addressing the loss fitness that occurs with hatchery stocks by emphasizing selection in the natural environment so that the population becomes adapted to habitats within each subbasin and ultimately achieves PNI > 0.5. "Local adaptation" is distinguished from "broodstock development" which selects for coho which can return to the Wenatchee and Methow rivers but does not address loss of fitness and adaptation to the natural environment.

Table 5-1. Proposed release numbers and locations for the Natural Production phases in the Wenatchee subbasin

Location	Implementation Phase Release	Support Phase (I)	Support Phase (F)	Long-Term (PFC)
	Number (one generation only)	Initial Release Number (est. three generations)	Final Release Number (PNI >0.5; est. two generations)	Periodic Supplementation may be needed to avoid extirpation again.
Chiwawa River	440,000	308,000	154,000	0
White River	210,000	147,000	73,500	0
Nason Creek	210,000	147,000	73,500	0
Little Wenatchee River	120,000	84,000	42,000	0
Upper Wenatchee River	100,000	70,000	35,000	0
Icicle Creek	75,000	50,000	25,000	100,000 (3 generations until we have shown the population can persist without continued supplementation)
Total	1,155,000	806,000	403,000	100,000

Table 5-2. Proposed release numbers and locations for the Natural Production phases in the Methow subbasin

Location	Implementation Phase Release Number (one generation only)	Support Phase (I) Initial Release Number (Est. 3 generations)	Support Phase (F) Final Release Number (PNI >0.5; Est. 2 generations)	Long-Term (PFC) Periodic supplementation may be needed to avoid extirpation again
Mid & Upper Methow	350,000	245,000	122,500	100k release may be retained at WNFH for 3 generations until it can be shown that the population will persist without supplementation.
Chewuch River	325,000	227,500	113,750	0
Twisp River	275,000	192,500	96,250	0
Wolf Creek	50,000	35,000	17,500	0
Total	1,000,000	700,000	350,000	100,000

The release numbers proposed for the Implementation Phase are generally based upon the predicted number of hatchery fish needed to initially seed the habitat. We used two methods to estimate the capacity of naturally produced smolts in the Wenatchee and Methow basins: 1) the smolt production model described by Zillges (1977) and 2) Ecosystem Diagnosis and Treatment (EDT) (Mobrand et. al. 1997).

The Zillges (1977) method is a smolt production model which has been used for Puget Sound and Washington coastal systems when actual data are not available (Seiler et al. 2004). The method described by Zillges (1977) uses stream length in larger tributaries, and stream area (length x width) in smaller tributaries to estimate coho smolt production. Bradford et al. (1997) found that coho salmon smolt abundance was primarily correlated with stream length, and that stream length was the most appropriate general measure of coho production. The number of smolts produced per unit of stream length was constant and independent of stream size (Bradford et al. 1997). Other variables such as discharge, stream gradient, and valley slope were not correlated with coho smolt production (Bradford et al. 1997). However, Bradford et al. (1997) cautioned that models which predict coho smolt production based on stream length, such as Zillges (1977), are suitable at the regional or watershed level, but the precision of a prediction for a single stream may be poor. Because different factors may be important in different streams at different times, there are no general predictive models that will yield precise estimates of coho smolt production potential (Bradford et al. 1997).

We also used EDT (Mobrand et al. 1997) to provide an estimate of juvenile and adult capacity in the Wenatchee and Methow rivers. In some cases, such as in the Little Wenatchee and the White River, the two estimates were almost identical, lending confidence to the estimates in these tributaries. In other cases, such as Icicle Creek and Nason Creek, the EDT estimates appeared

unrealistically low, based on data collected to date, and the Zillges (1977) method appeared unrealistically high. In cases with a discrepancy between the estimates, we used the mid-point between the two values to estimate capacity.

The capacity values were used as upper limits for the program. To minimize potential species interactions, the actual release numbers will result in seeding levels below the estimated capacity, but are predicted to result in an adequate spawning escapement for which natural selection will begin the local adaptation process.

After three years (one coho generation) of Implementation Phase releases, we propose to reduce the release numbers by 30% as we enter the Natural Production Support Phase.

5.3.2 Natural Production Support Phase

This phase will begin following the Implementation Phase (FY 2014 in the Wenatchee subbasin) and will be terminated after four generations (12 years) in 2026 unless it can be demonstrated that continued natural production support and local adaptation is still required to reach project goals. After termination of the program, periodic hatchery supplementation may be needed to prevent a second extirpation and to achieve harvest goals. To address the fitness loss commonly associated with hatchery programs, the Support Phase uses the fitness computations in the AHA model to guide program management, with the goal of reducing domestication selection and increasing local adaptation. The support phase will result in a fully integrated population which receives greater selective pressures from the natural environment than from the hatchery environment (PNI > 0.5), and eventually achieves a self-sustaining population.

Initial release numbers will be reduced 30% from Implementation Phase release numbers. The initial proportion of natural origin fish in the broodstock (pNOB) will be greater than or equal to 35%. When this initial goal is met (pNOB > 35%) we will continue to reduce the size of the supplementation program while increasing the pNOB (up to 80%) and limiting the proportion of hatchery fish on the spawning grounds (pHOS; 65%) until we have reached a PNI value of 0.50 or greater.

During NPSP in the Wenatchee, broodstock capture will continue to focus on upper basin collection from sites listed in BDP2 and NPIP. The majority of broodstock collection will occur at tributary facilities (Nason Creek, White River, and Chiwawa River). Implementation success within multiple streams and watersheds will drive collection numbers during the NPSP. Shortfalls in collection goals will result in utilizing Tumwater Dam and lower basin sites (Dryden Dam, Icicle side channel, and LNFH). Annual broodstock protocols will address collection numbers and bi-weekly quotas.

In the Methow, broodstock collection will continue in the same locations as in NPIP.

5.4 AHA Calculations

AHA computations for each release tributary depict the transition from a domesticated hatchery stock to a fully integrated supplementation program, and finally to a self- sustaining, naturally reproducing population. The computations assume the habitat improvement schedule developed for the UCSRB (Section 2.4.4) will occur and that habitat capacity and associated productivity will increase to their target values. A summary of the AHA calculations for each targeted tributary for coho restoration is in Tables 5-3-5-10 for the Wenatchee subbasin and in Tables 5-11-5-16 for the Methow subbasin.

We are aware of the need for caution when using the AHA or any other single model to generate specific objectives, numerical or otherwise, as described by the ISRP and ISAB (2005). However, project proponents have found minimal literature or empirical data to guide the transition from a non-local domesticated hatchery stock to a population locally adapted to the natural environment. The AHA model provides a framework from which the loss of fitness, or domestication, can be addressed in the form of a working hypothesis. We believe the proposed mid-Columbia coho reintroduction plan presents a unique opportunity to test some of the assumptions of the AHA model, as they pertain to domestication and local adaptation, in the absence of genetic risk⁹ to a native coho population.

5.4.1 Wenatchee Subbasin AHA Calculations

Table 5-3. Natural production phase goals and expected results (based on AHA calculations) for the Chiwawa River

Natural Production Phase	Prod*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.52	1435	440,000	10%	90%	11%	81%	0.12	1656	304	251	1327
Support (I)	1.52	1435	308,000	35%	75%	35%	77%	0.31	1293	376	246	1086
Support (F)	1.75	1435	154,000	80%	65%	80%	60%	0.58	610	541	392	971
Recovered (PFC)	2.10	1500	None	N/A	N/A	N/A	N/A	1.0	0	449	449	449

^{*} Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Mid-Columbia Coho Restoration Program Master Plan

⁹ Genetic risk is the probability of an event or activity having and adverse genetic consequence. Adverse consequences include 1) extinction, 2) loss of within population genetic diversity, 3) loss of among-population genetic diversity, and 4) domestication (Busak and Currens 1995).

Table 5-4. Harvest rates used in projecting the results for Chiwawa River natural production phases

Natural	Natura	al Origin Retu	rns (NOR)	Hatch	ery Origin Ret	turn (HOR)	Total Harvest		
Production Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count	
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	315	
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	261	
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	170	
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	134	

Table 5-5. Natural production phase goals and expected results (based on AHA calculations) for the White River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.63	717	210,000	10%	90%	11%	78%	0.12	783	165	140	648
Support (I)	1.63	717	157,000	35%	75%	35%	73%	0.32	614	210	148	547
Support (F)	1.75	717	73,500	80%	65%	80%	57%	0.59	293	279	208	669
Recovered (PFC)	2.20	1077	None	N/A	N/A	N/A	N/A	1.0	0	363	363	363

^{*} Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-6. Harvest rates used it projecting the results for White River natural production phases

Natural Production	Natura	al Origin Retu	rns (NOR)	Hatch	ery Origin Ret	turn (HOR)	Total Harvest		
Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count	
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	151	
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	127	
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	83	
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	109	

Table 5-7. Natural production phase goals and expected results (based on AHA calculations) for Nason Creek

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.13	709	210,000	10%	90%	11%	84%	0.11	790	121	96	609
Support (I)	1.13	709	147,000	35%	75%	35%	83%	0.29	609	140	79	473
Support (F)	1.50	709	73,500	80%	65%	80%	64%	0.51	291	228	157	434
Recovered (PFC)	2.10	900	None	N/A	N/A	N/A	N/A	1.0	0	281	281	281

^{*} Initial productivity rates are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-8. Harvest rates used in projecting the results for Nason Creek natural production phases

Natural Production	Natura	al Origin Retu	rns (NOR)	Hatch	ery Origin Ret	Total Harvest		
Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	147
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	118
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	78
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	84

Table 5-9. Natural production phase goals and expected results (based on AHA calculations) for the Little Wenatchee River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.50	447	120,000	10%	90%	11%	80%	0.12	455	90	75	370
Support (I)	1.50	717	84,000	35%	75%	35%	75%	0.32	354	112	76	306
Support (F)	1.65	717	42,000	80%	65%	80%	56%	0.57	167	164	123	282
Recovered (PFC)	2.10	1077	None	N/A	N/A	N/A	N/A	1.0	0	254	254	254

^{*} Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement.

Table 5-10. Harvest rates used in projecting the results for Little Wenatchee River natural production phases

Natural	Natu	ral Origin Retu	rns (NOR)	Hate	hery Origin Re	turn (HOR)	Total Harvest		
Production Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	HOR/NOR	Count	
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	87	
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	72	
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	48	
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	59	

5.4.2 Methow Subbasin AHA Calculations

Table 5-11. Natural production phase goals and expected results (based on AHA calculations) for the mid and upper Methow River

Natural Production Phase	Prod*	Est. Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.19	1836	350,000	10%	90%	11%	81%	0.12	1339	244	202	1073
Support (I)	1.19	1836	245,000	35%	75%	35%	80%	0.31	1018	304	201	862
Support (F)	1.35	1836	122,500	80%	60%	80%	57%	0.58	481	461	343	803
Recovered (PFC)	1.69	2000	None	N/A	N/A	N/A	N/A	1.0	0	374	374	374

^{*} Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement.

Table 5-12. Harvest rates used in projecting results for mid-and upper Methow River natural production phases

Natural	Natura	al Origin Retu	rns (NOR)	Hatch	ery Origin Ret	turn (HOR)	Total Harvest		
Production Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count	
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	254	
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	206	
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	138	
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	112	

Table 5-13. Natural production phase goals and expected results (based on AHA calculations) for the Chewuch River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.10	1415	325,000	10%	90%	11%	83%	0.11	1223	196	157	952
Support (I)	1.10	1415	227,500	35%	75%	35%	82%	0.30	944	232	137	750
Support (F)	1.45	1415	113,750	80%	6%	80%	59%	0.58	451	399	289	705
Recovered (PFC)	1.79	2000	None	N/A	N/A	N/A	N/A	1.0	0	456	459	456

^{*} Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-14. Harvest rates used to project results for Chewuch River natural production phases

Natural Production	Natura	al Origin Retu	rns (NOR)	Hatch	ery Origin Ret	Total Harvest		
Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	229
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	186
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	125
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	83

Table 5-15. Natural production phase goals and expected results (based on AHA calculations for Twisp River

Natural Production Phase	Prod.*	Adult Capacity	NPIP Smolt Release Number	pNOB Goal	pHOS Goal	pNOB Realized	pHOS Realized	PNI	Avg. Predicted HOR	Avg. Predicted NOR	Avg. NOR Escape- ment	Avg. Total Escape- ment
Implementation	1.32	926	275,000	10%	90%	11%	82%	0.12	1027	176	143	810
Support (I)	1.32	926	192,500	35%	75%	35%	80%	0.30	803	215	134	655
Support (F)	1.45	926	95,250	80%	60%	80%	65%	0.55	349	277	184	533
Recovered (PFC)	1.64	1000	None	N/A	N/A	N/A	N/A	1.0	0	193	193	193

^{*} Initial productivity rates based on are based upon current conditions as predicted by EDT. Increased productivity is predicted to result from habitat improvement

Table 5-16. Harvest rates used to project results for Twisp River natural production phases

Natural Daniel	Natura	al Origin Retu	rns (NOR)	Hatch	ery Origin Ret	Total Harvest		
Production Phase	Mixed Stock	Mainstem	Terminal	Mixed Stock	Mainstem	Terminal	NOR/HOR	Count
Implementation	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	194
Support (I)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	160
Support (F)	0.10	0.00	0.00	0.10	0.05	0.00	0.10/0.15	99
Recovered (PFC)	0.10	0.10	0.05	N/A	N/A	N/A	0.23/0.00	58

It should be noted that wherever possible, we will seek to emphasize local adaptation which will include tributary-specific adaptation. However, we are not proposing to build additional weirs or capture facilities. We will promote local adaptation to the extent possible within the limitation of existing facilities and technology. This plan assumes that weirs currently proposed for chinook salmon on Nason and the White River would also be available for coho capture. In the Methow, the only tributary adult capture weir currently in operation is on the Twisp River, funded by Douglas County PUD (DCPUD) and operated by WDFW. Feasibility work is under way by DCPUD to build another tributary weir on the Chewuch River and possibly the upper Methow River mainstem at Foghorn Dam.

During the Natural Production phases, we recognize that abundance of adult returns may vary greatly from year to year. For this reason we have developed schedules for the disposition of returning adult coho within each Natural Production phase. These schedules are shown in Tables 5-17 – 5-19 for the Wenatchee and Tables 5-20 – 5-22 for the Methow. The grey shaded areas of these tables indicate that the success criteria for each of the Natural Production phases are being met. Successful implementation of the habitat initiative schedule developed for the UCSRB (Section 2.4.4) will increase the proportion of time the population will remain in the shaded "goal range" and reduce dependence upon hatchery supplementation.

Table 5-17. Management schedule for the disposition of adult returns to the Wenatchee subbasin during the Natural Production Implementation Phase

		≥100	500	1000	1500	2000	4000	5000
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _B , 450 _S , 0 _H	1274 _B , 726 _S , 0 _H	1274 _B , 2726 _S , 0 _H	1274 _B , 3726 _S , 0 _H
≥100	NOR	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _B , 450 _S , 0 _H	1210 _B , 790 _S , 0 _H	1210 _B , 2790 _S , 0 _H	1210 _B , 3534 _S , 256 _H
500	NOR	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	294 _B , 206 _S , 0 _H	134 _B , 366 _S , 0 _H	134 _B , 366 _S , 0 _H	134 _B , 366 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _B , 450 _S , 0 _H	1210 _B , 790 _S , 0 _H	1210 _B , 2790 _S , 0 _H	1210 _B , 3034 _S , 756 _H
1000	NOR	700 _B , 300 _S , 0 _H	700 _B , 300 _S , 0 _H	644 _B , 356 _S , 0 _H	294 _B , 706 _S , 0 _H	134 _B , 866 _S , 0 _H	134 _B , 866 _S , 0 _H	134 _B , 866 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _{B,} 300 _S , 0 _H	1050 _{B,} 450 _S , 0 _H	1210 _B , 790 _S , 0 _H	1210 _B , 2534 _S , 256 _H	1210 _B , 2534 _S , 1256 _H
1500	NOR	1050 _B , 450 _S , 0 _H	994 _B , 506 _S , 0 _H	644 _B , 856 _S , 0 _H	294 _B , 1206 _S , 0 _H	134 _B , 1366 _S , 0 _H	134 _B , 1366 _S , 0 _H	134 _B , 1366 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _{B,} 300 _S , 0 _H	1050 _{B,} 450 _S , 0 _H	1210 _B , 790 _S , 0 _H	1210 _B , 2034 _S , 756 _H	1210 _B , 2034 _S , 1756 _H
2000	NOR	1274 _B , 726 _S , 0 _H	994 _B , 1006 _S , 0 _H	644 _B , 1356 _S , 0 _H	294 _B , 1706 _S , 0 _H	134 _B , 1866 _S , 0 _H	134 _B , 1866 _S , 0 _H	134 _B , 1866 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _{B,} 300 _S , 0 _H	1050 _B , 194 _S , 156 _H	1210 _B , 34 _S , 756 _H	1210 _B , 34 _S , 2756 _H	1210 _B , 34 _S , 3756 _H
4000	NOR	1274 _B , 2726 _S , 0 _H	994 _B , 3006 _S , 0 _H	644 _B , 3356 _S , 0 _H	294 _B , 3706 _S , 0 _H	134 _B , 3866 _S , 0 _H	134 _B , 3866 _S , 0 _H	134 _B , 3866 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	244 _B , 0 _S , 256 _H	244 _B , 0 _S , 756 _H	244 _B , 0 _S , 1256 _H	244 _B , 0 _S , 1756 _H	244 _{B,} 0 _S , 3756 _H	244 _{B,} 0 _S , 4756 _H
5000	NOR	1274 _B , 3726 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Implementation Phase are being met. Implementation Phase Objectives: B=1344 (10% NOR, 90%HOR), no restrictions on pHOS. Assumptions include an adult capacity of 3900.

Table 5-18. Management schedule for the disposition of adult returns to the Wenatchee subbasin during the Natural Production Support Phase (Initial)

		≥100	500	1000	1500	2000	4000	5000
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _{B,} 300 _S , 0 _H	831 _{B,} 669 _S , 0 _H	831 _B , 1169 _S , 0 _H	831 _B , 3169 _S , 0 _H	831 _B , 3830 _S , 339 _H
≥100	NOR	$70_{B}, 30_{S}, 0_{H}$	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _в , 30 _s , 0 _н	70 _B , 30 _S , 0 _H	70 _в , 30 _s , 0 _н
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	586 _{B,} 414 _S , 0 _H	586 _{B,} 914 _S , 0 _H	586 _B , 1414 _S , 0 _H	586 _B , 3414 _S , 0 _H	586 _B , 3715 _S , 699 _H
500	NOR	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	315 _B , 185 _S , 0 _H	315 _B , 185 _S , 0 _H	315 _B , 185 _S , 0 _H	315 _B , 185 _S , 0 _H	315 _B , 185 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	586 _{B,} 414 _S , 0 _H	586 _{B,} 914 _S , 0 _H	586 _{B,} 1414 _S , 0 _H	586 _B , 3215 _S , 199 _H	586 _B , 3215 _S , 1199 _H
1000	NOR	700 _B , 300 _S , 0 _H	551 _B , 449 _S , 0 _H	315 _B , 685 _S , 0 _H	315 _B , 685 _S , 0 _H	315 _B , 685 _S , 0 _H	315 _B , 685 _S , 0 _H	315 _B , 685 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	586 _{B,} 414 _S , 0 _H	586 _{B,} 914 _S , 0 _H	586 _{B,} 1414 _S , 0 _H	586 _{B,} 2715 _S , 699 _H	586 _B , 2715 _S , 1699 _H
1500	NOR	831 _B , 669 _S , 0 _H	551 _B , 949 _S , 0 _H	315 _B , 1185 _S , 0 _H	315 _B , 1185 _S , 0 _H	315 _B , 1185 _S , 0 _H	315 _B , 1185 _S , 0 _H	315 _B , 1185 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	586 _B , 414 _S , 0 _H	586 _B , 914 _S , 0 _H	586 _{B,} 1414 _S , 0 _H	586 _B , 2215 _S , 2801 _H	586 _B , 2215 _S , 2199 _H
2000	NOR	831 _в , 1169 _s , 0 _н	551 _в , 1449 _s , 0 _н	315 _в , 1685 _s , 0 _н	315 _в , 1685 _s , 0 _н	315 _в , 1685 _s , 0 _н	315 _B , 1685 _S , 0 _H	315 _в , 1685 _s , 0 _н
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	586 _B , 414 _S , 0 _H	586 _B , 215 _S , 699 _H	586 _B , 215 _S , 1199 _H	586 _B , 215 _S , 3199 _H	586 _B , 215 _S , 4199 _H
4000	NOR	831 _в , 3169 _s , 0 _н	551 _в , 3449 _s , 0 _н	315 _в , 3685 _s , 0 _н	315 _в , 3685 _s , 0 _н	315 _в , 3685 _s , 0 _н	315 _в , 3685 _s , 0 _н	315 _B , 3685 _S , 0 _H
	HOR	0 _B , 0 _S , 100 _H	0 _в , 0 _s , 500 _н	0 _B , 0 _S , 1000 _H	0 _в , 0 _s , 1500 _н	0 _B , 0 _S , 2000 _H	0 _B , 0 _S , 4000 _H	0 _B , 0 _S , 5000 _H
5000	NOR	901 _в , 3900 _s , 199 _н	901 _в , 3900 _s , 199 _н	901 _в , 3900 _s , 199 _н	901 _B , 3900 _S , 199 _H	901 _в , 3900 _s , 199 _н	901 _в , 3900 _s , 199 _н	901 _в , 3900 _s , 199 _н

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Initial Support Phase are being met. Initial Support Phase Objectives: Broodstock = 901 (35% NOR, 65%HOR), pHOS = 75%. Assumptions include an adult capacity of 3900.

Table 5-19. Management schedule for the disposition of adult returns to the Wenatchee subbasin during the Natural Production Support Phase (Final)

		≥100	500	1000	1500	2000	4000	5000
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	376 _{B,} 624 _S , 0 _H	376 _{B,} 1124 _S , 0 _H	376 _{B,} 1624 _S , 0 _H	376 _{B,} 2797 _S , 827 _H	376 _{B,} 2797 _S , 1827 _H
≥100	NOR	70 _B , 30 _S , 0 _H	$70_B, 30_S, 0_H$	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	96 _B , 404 _S , 0 _H	96 _B , 904 _S , 0 _H	96 _B , 1404 _S , 0 _H	96 _B , 1904 _S , 0 _H	96 _B , 3750 _S , 154 _H	96 _B , 3750 _S , 1154 _H
500	NOR	350 _в , 150 _s , 0 _н	350 _в , 150 _s , 0 _н	350 _в , 150 _s , 0 _н	350 _в , 150 _s , 0 _н	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	90 _B , 410 _S , 0 _H	90 _B , 910 _S , 0 _H	90 _B , 1410 _S , 0 _H	90 _B , 1910 _S , 0 _H	90 _B , 3256 _S , 654 _H	90 _B , 3256 _S , 1654 _H
1000	NOR	376 _B , 624 _S , 0 _H	356 _B , 644 _S , 0 _H	356 _B , 644 _S , 0 _H	356 _в , 644 _s , 0 _н	356 _B , 644 _S , 0 _H	356 _B , 644 _S , 0 _H	356 _B , 644 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	90 _B , 410 _S , 0 _H	90 _B , 910 _S , 0 _H	90 _B , 1410 _S , 0 _H	90 _B , 1910 _S , 0 _H	90 _B , 2756 _S , 1154 _H	90 _B , 2756 _S , 2154 _H
1500	NOR	376 _в , 1124 _S , 0 _Н	356 _в , 1144 _s , 0 _н	356 _в , 1144 _s , 0 _н	356 _в , 1144 _s , 0 _н	356 _в , 1144 _s , 0 _н	356 _в , 1144 _s , 0 _н	356 _в , 1144 _s , 0 _н
	HOR	70 _B , 30 _S , 0 _H	90 _B , 410 _S , 0 _H	90 _B , 910 _S , 0 _H	90 _B , 1410 _S , 0 _H	90 _B , 1910 _S , 0 _H	90 _B , 2346 _S , 1564 _H	90 _B , 2346 _S , 2564 _H
2000	NOR	376 _в , 1624 _s , 0 _н	356 _в , 1554 _s , 0 _н	356 _в , 1554 _s , 0 _н	356 _в , 1554 _s , 0 _н	356 _в , 1554 _s , 0 _н	356 _в , 1554 _s , 0 _н	356 _в , 1554 _s , 0 _н
	HOR	70 _B , 30 _S , 0 _H	90 _B , 256 _S , 154 _H	90 _B , 256 _S , 654H	90 _B , 256 _S , 1154 _H	90 _B , 256 _S , 1654 _H	90 _B , 256 _S , 3654 _H	90 _B , 256 _S , 4654 _H
4000	NOR	376 _в , 3624 _s , 0 _н	356 _в , 3644 _s , 0 _н	356 _в , 3644 _s , 0 _н	356 _в , 3644 _s , 0 _н	356 _в , 3644 _S , 0 _н	356 _в , 3644 _s , 0 _н	356 _в , 3644 _S , 0 _н
	HOR	0 _B , 0 _S , 100 _H	0 _B , 0 _S , 500 _H	0 _B , 0 _S , 1000 _H	0 _B , 0 _S , 1500 _H	0 _B , 0 _S , 2000 _H	0 _B , 0 _S , 4000 _H	0 _B , 0 _S , 5000 _H
5000	NOR	446 _в , 3900 _s , 854 _н	446 _в , 3900 _s , 854 _н	446 _в , 3900 _s , 854 _н	446 _в , 3900 _s , 854 _н	446 _в , 3900 _s , 854 _н	446 _в , 3900 _s , 854 _н	446 _в , 3900 _s , 854 _н

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Final Support Phase are being met. Final Support Phase Objectives: Broodstock = 446 (80% NOR, 20%HOR), pHOS = 60%. Assumptions include an adult capacity of 3900.

Table 5-20. Management schedule for the disposition of adult returns to the Methow subbasin during the Natural Production Implementation Phase

·		≥100	500	1000	1500	2000	4000	5000
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _B , 450 _S , 0 _H	1141 _B , 859 _S , 0 _H	1141 _B , 2860 _S , 0 _H	1141 _B , 3859 _S , 0 _H
≥100	NOR	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _B , 450 _S , 0 _H	1087 _B , 913 _S , 0 _H	1087 _B , 2913 _S , 0 _H	1087 _В , 3524 _S , 389 _Н
500	NOR	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	161 _B , 339 _S , 0 _H	124 _B , 376 _S , 0 _H	124 _B , 376 _S , 0 _H	124 _B , 376 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _{B,} 450 _S , 0 _H	1087 _B , 913 _S , 0 _H	1087 _B , 2913 _S , 0 _H	1087 _B , 3024 _S , 889 _H
1000	NOR	700 _B , 300 _S , 0 _H	700 _B , 300 _S , 0 _H	511 _B , 489 _S , 0 _H	161 _B , 839 _S , 0 _H	124 _B , 876 _S , 0 _H	124 _B , 876 _S , 0 _H	124 _B , 876 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _{B,} 300 _S , 0 _H	1050 _{B,} 450 _S , 0 _H	1087 _B , 913 _S , 0 _H	1087 _B , 2524 _S , 389 _H	1087 _B , 2524 _S , 1389 _H
1500	NOR	1050 _B , 450 _S , 0 _H	861 _B , 639 _S , 0 _H	511 _B , 989 _S , 0 _H	161 _B , 1339 _S , 0 _H	124 _B , 1376 _S , 0 _H	124 _B , 1376 _S , 0 _H	124 _B , 1376 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _{B,} 300 _S , 0 _H	1050 _{B,} 450 _S , 0 _H	1087 _B , 913 _S , 0 _H	1087 _B , 2024 _S , 889 _H	1087 _B , 2024 _S , 1889 _H
2000	NOR	1141 _B , 859 _S , 0 _H	861 _B , 1139 _S , 0 _H	511 _B , 1489 _S , 0 _H	161 _B , 1839 _S , 0 _H	124 _B , 1876 _S , 0 _H	124 _B , 1876 _S , 0 _H	124 _B , 1876 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	1050 _B , 61 _S , 389 _H	1087 _B , 24 _S , 889 _H	1087 _B , 24 _S , 2889 _H	1087 _B , 24 _S , 3889 _H
4000	NOR	1141 _B , 2859 _S , 0 _H	861 _B , 3139 _S , 0 _H	511 _B , 3489 _S , 0 _H	161 _B , 3839 _S , 0 _H	124 _B , 3876 _S , 0 _H	124 _B , 3876 _S , 0 _H	124 _B , 3876 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	21 _B , 0 _S , 479 _H	21 _B , 0 _S , 979 _H	21 _B , 0 _S , 1479 _H	21 _B , 0 _S , 1979 _H	21 _B , 0 _S , 3979 _H	21 _B , 0 _S , 4979 _H
5000	NOR	1141 _B , 8859 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H	1100 _B , 3900 _S , 0 _H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Implementation Phase are being met. Implementation Phase Objectives: B=1211 (10% NOR, 90%HOR), no restrictions on pHOS. Assumptions include an adult capacity of 3900.

Table 5-21. Management schedule for the disposition of adult returns to the Methow subbasin during the Natural Production Support Phase (Initial)

		≥100	500	1000	1500	2000	4000	5000
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	700 _B , 300 _S , 0 _H	778 _{B,} 722 _S , 0 _H	778 _B , 1222 _S , 0 _H	778 _B , 3222 _S , 0 _H	778 _B , 3870 _S , 352 _H
≥100	NOR	$70_{B}, 30_{S}, 0_{H}$	$70_{B}, 30_{S}, 0_{H}$	$70_{B}, 30_{S}, 0_{H}$	$70_B, 30_S, 0_H$	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	551 _{B,} 449 _S , 0 _H	551 _{B,} 949 _S , 0 _H	551 _{B,} 1449 _S , 0 _H	551 _{B,} 3449 _S , 0 _H	551 _B , 3697 _S , 752 _H
500	NOR	350 _B , 150 _S , 0 _H	350 _B , 150 _S , 0 _H	297 _B , 203 _S , 0 _H	297 _B , 203 _S , 0 _H	297 _B , 203 _S , 0 _H	297 _B , 203 _S , 0 _H	297 _B , 203 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	551 _{B,} 449 _S , 0 _H	551 _{B,} 949 _S , 0 _H	551 _{B,} 1449 _S , 0 _H	551 _{B,} 3197 _S , 252 _H	551 _B , 3197 _S , 1252 _H
1000	NOR	700 _B , 300 _S , 0 _H	498 _B , 502 _S , 0 _H	297 _B , 703 _S , 0 _H	297 _B , 703 _S , 0 _H	297 _B , 703 _S , 0 _H	297 _B , 703 _S , 0 _H	297 _B , 703 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	551 _{B,} 449 _S , 0 _H	551 _{B,} 949 _S , 0 _H	551 _{B,} 1449 _S , 0 _H	551 _{B,} 2697 _S , 752 _H	551 _{B,} 2697 _S , 1752 _H
1500	NOR	778 _B , 722 _S , 0 _H	498 _B , 1002 _S , 0 _H	297 _B , 1203 _S , 0 _H	297 _B , 1203 _S , 0 _H	297 _B , 1203 _S , 0 _H	297 _B , 1203 _S , 0 _H	297 _B , 1203 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	551 _{B,} 449 _S , 0 _H	551 _B , 949 _S , 0 _H	551 _{B,} 1449 _S , 0 _H	551 _B , 2197 _S , 1252 _H	551 _{B,} 2197 _S , 2252 _H
2000	NOR	778 _B , 1222 _S , 0 _H	498 _в , 1502 _s , 0 _н	297 _в , 1703 _s , 0 _н	297 _B , 1703 _S , 0 _H	297 _B , 1703 _S , 0 _H	297 _в , 1703 _s , 0 _н	297 _В , 1703 _S , 0 _Н
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	551 _B , 197 _S , 252 _H	551 _B , 197 _S , 752 _H	551 _B , 197 _S , 1252 _H	551 _{В,} 197 _S , 3252 _Н	551 _{B,} 197 _S , 4252 _H
4000	NOR	778 _B , 3222 _S , 0 _H	498 _в , 3502 _s , 0 _н	297 _в , 3703 _s , 0 _н	297 _B , 3703 _S , 0 _H	297 _B , 3703 _S , 0 _H	297 _в , 3703 _s , 0 _н	297 _В , 3703 _S , 0 _Н
	HOR	0 _B , 0 _S , 100 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H
5000	NOR	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H	848 _B , 3900 _S , 252 _H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Initial Support Phase are being met. Initial Support Phase Objectives: Broodstock = 848 (35% NOR, 65%HOR), pHOS = 75%. Assumptions include an adult capacity of 3900.

Table 5-22. Management schedule for the disposition of adult returns to the Methow subbasin during the Natural Production Support Phase (Final)

		≥100	500	1000	1500	2000	4000	5000
	HOR	70 _B , 30 _S , 0 _H	350 _B , 150 _S , 0 _H	354 _B , 646 _S , 0 _H	354 _B , 1146 _S , 0 _H	354 _B , 1646 _S , 0 _H	354 _B , 3646 _S , 0 _H	354 _B , 3870 _S , 776 _H
≥100	NOR	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H	70 _B , 30 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	85 _B , 415 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 1415 _S , 0 _H	85 _B , 1915 _S , 0 _H	85 _B , 3739 _S , 176 _H	85 _B , 3739 _S , 1176 _H
500	NOR	350 _в , 150 _s , 0 _н	339 _B , 161 _S , 0 _H	339 _B , 161 _S , 0 _H	339 _B , 161 _S , 0 _H	339 _B , 161 _S , 0 _H	339 _B , 161 _S , 0 _H	339 _B , 161 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 1415 _S , 0 _H	85 _B , 1915 _S , 0 _H	85 _B , 3239 _S , 676 _H	85 _B , 3239 _S , 1676 _H
1000	NOR	354 _в , 626 _s , 0 _н	339 _в , 661 _s , 0 _н	339 _в , 661 _s , 0 _н	339 _в , 661 _s , 0 _н	339 _в , 661 _s , 0 _н	339 _в , 661 _s , 0 _н	339 _в , 661 _s , 0 _н
	HOR	70 _B , 30 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 1415 _S , 0 _H	85 _B , 1915 _S , 0 _H	85 _B , 2739 _S , 1176 _H	85 _B , 2739 _S , 2176 _H
1500	NOR	354 _в ,1126 _s , 0 _н	339 _в , 1161 _s , 0 _н	339 _в , 1161 _s , 0 _н	339 _в , 1161 _s , 0 _н	339 _в , 1161 _s , 0 _н	339 _в , 1161 _s , 0 _н	339 _в , 1161 _s , 0 _н
	HOR	70 _B , 30 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 915 _S , 0 _H	85 _B , 1415 _S , 0 _H	85 _B , 1915 _S , 0 _H	85 _B , 2239 _S , 1676 _H	85 _B , 2239 _S , 2676 _H
2000	NOR	354 _B ,1626 _S , 0 _H	339 _в ,1661 _s , 0 _н	339 _B ,1661 _S , 0 _H	339 _B ,1661 _S , 0 _H	339 _в ,1661 _S , 0 _Н	339 _B ,1661 _S , 0 _H	339 _B ,1661 _S , 0 _H
	HOR	70 _B , 30 _S , 0 _H	85 _B , 231 _S , 184 _H	85 _B , 239 _S , 676H	85 _B , 239 _S , 1176 _H	85 _B , 239 _S , 1676 _H	85 _B , 239 _S , 3676 _H	85B, 239S, 4676H
4000	NOR	354 _B ,3626 _S , 0 _H	339 _B ,3661 _S , 0 _H	339 _B ,3661 _S , 0 _H	339 _B ,3661 _S , 0 _H	339 _в ,3661 _s , 0 _н	339 _B ,3661 _S , 0 _H	339 _в ,3661 _s , 0 _н
	HOR	0 _B , 0 _S , 100 _H	0 _B , 0 _S , 500 _H	0 _B , 0 _S , 1000 _H	0 _B , 0 _S , 1500 _H	0 _B , 0 _S , 2000 _H	0 _B , 0 _S , 4000 _H	0 _B , 0 _S , 5000 _H
5000	NOR	424 _B , 3900 _S , 676 _H	424 _B , 3900 _S , 676 _H	424 _B , 3900 _S , 676 _H	424 _B , 3900 _S , 676 _H	424 _B , 3900 _S , 676 _H	424 _B , 3900 _S , 676 _H	424 _B , 3900 _S , 676 _H

B=broodstock, S= spawning escapement, H=terminal harvest.

Grey shaded cells indicate that objectives for the Initial Support Phase are being met. Initial Support Phase Objectives: Broodstock = 424 (80% NOR, 20%HOR), pHOS = 60. Assumptions include an adult capacity of 3900.

5.5 Habitat Improvement Phase

The Habitat Improvement Phase (HIP) of the proposed Mid-Columbia Coho Restoration Program is expected to last 10-15 years and seeks to coordinate and implement the habitat improvement schedule developed for the UCSRB. Results of this schedule are expected to improve productivity and capacity of coho salmon, spring chinook salmon, bull trout, and steelhead. We propose that the MCCRP provide 50% of the cost of a staff member (the other half funded by Pacific Coastal Salmon Recovery Fund [PCSRF]) to identify, propose, solicit funds and implement the UCSRB program in the Wenatchee and Methow rivers. See Section 2.4.4.

Funding for coho habitat improvements is expected to be closely associated with ongoing activities within the Upper Columbia Province. The UCSRB is expected to submit a Salmon Recovery Plan to NOAA Fisheries early in 2006. Included in this plan is a list of limiting factors identified for each watershed (approximately HUC 5 scale). Associated with this planning effort, the Upper Columbia Regional Technical Team¹⁰ has developed a Draft Implementation Schedule that describes site-specific habitat protection, restoration and enhancement actions (and a sequence for the implementation of actions) that would address these limiting factors and benefit all salmonid populations throughout the Province (Tables 2-5 and 2-6, Section 2.4.4). Additional public involvement and modeling (with both EDT and AHA) is needed before a final Implementation Schedule is adopted by the Board and submitted as an integral part of the Salmon Recovery Plan. Future modeling and evaluation is expected not only for coho salmon, but for spring chinook, steelhead and bull trout as well.

The Yakama Nation is working closely with other tribal, state, federal and local governments to coordinate funding needs identified in this Upper Columbia Implementation Schedule. It is anticipated this schedule will substantially drive funding decisions associated with tributary mitigation described in the ESA Section 10 Habitat Conservation Plans for both Chelan and Douglas County PUDs, as well as ESA Section 7 mitigation and future re-licensing obligations by Grant County PUD. Yakama Nation fisheries staff fully expect these funds will serve as significant cost-share contributions to the NPCC Fish and Wildlife Program as well as the State Salmon Recovery Funding Board (SRFB) annual allocations. Additionally, the Yakama Nation currently receives approximately \$400,000 annually through the Pacific Coast Salmon Recovery Funds (PCSRF). Included in the 2006 PCSRF allocation is a full-time position for a Habitat Project Development and Coordination specialist who will work through the Yakama Nation Coho Program office in Wenatchee, Washington, focusing on activities specifically in the Columbia Cascade Province. Clearly, many other funding sources are currently being used to improve salmonid habitat conditions in the Province, and these sources are also being considered by the RTT and Board in the development of the Implementation Schedule.

¹⁰ The Regional Technical Team is a body of professional fisheries and hydrologic scientists and resource managers that provide technical input to the Upper Columbia Salmon Recovery Board for habitat project development and regional monitoring.

Chapter 6. Proposed Facilities



- 6.1 Broodstock Capture Facilities
- 6.2 Rearing Facilities
- 6.3 Acclimation Facilities

Chapter 6. Proposed Facilities

The Mid-Columbia Restoration Plan continues the reintroduction of coho salmon in the Wenatchee and Methow subbasins through the artificial production and acclimation/release of the progeny of locally captured broodstock. Hatchery rearing is proposed mainly due to the high egg to pre-smolt survival rates that result from their controlled environments. Acclimation is proposed to provide smolts with a gradual introduction to the wild and to imprint them on areas that have suitable habitat

6.1 Broodstock Capture Facilities

All proposed broodstock capture facilities already exist or are being planned for development by other agencies. Trap operations might need to change to meet broodstock collection goals for the proposed coho program; effects of operational changes on listed and sensitive species would be evaluated during NEPA and ESA processes.

6.1.1 Wenatchee Subbasin

Dryden Dam

Dryden Dam collection facility is located at RK 28.2 on the Wenatchee River. This facility is owned and maintained by CCPUD. Both WDFW and YN collect steelhead, summer chinook and coho broodstock from Dryden Dam. This site has been instrumental for coho broodstock collection since the inception of the program. There are two trapping facilities within the Dryden Dam structure: left bank and right bank.

The left bank collection facility is located on the northern shore of the river and operates passively. An impassable concrete wall parallels the entrance to the trap. This prevents fish from migrating past the trap. As the fish enter, a series of ladders provide passage upstream. A V-trap weir allows passage into the holding area. The left bank trap is checked once a day, while operating, to provide brood collection and/or upstream passage of adult fish.

Dryden right bank is located directly across from the left bank facility and is also a passive trap. A small concrete apron spans across approximately half the Wenatchee River. An expandable/retractable, water-filled bladder is positioned atop the apron to provide blockage for migrating fish. Fish move through the right bank facility and into a holding area via a V-trap weir. Daily checks are made to allow for passage or collection of fish as long as the trap is operational. On the last trapping day of the week, both facilities are made passive to provide upstream movement on non-trapping days. Collection efficiencies at these locations depend on Wenatchee River flows. Higher flows result in reduced trapping efficiencies because of an accessible, migratory portion located in the middle portion of the dam.

Tumwater Dam

Tumwater Dam is located at RK 49.4 on the Wenatchee River. This facility is owned and maintained by CCPUD. YN and WDFW are co-operators of this facility. Tumwater Dam can be actively or passively operated, depending on fish numbers and available personnel.

Passive trapping allows migrating fish to move through a series of pools and enter a holding facility. Once in the holding facility, a denil fish ladder leads fish to a chute where they are shunted into another holding facility. A hopper hauls fish out of the holding area where they are sorted, identified, and either kept for broodstock purposes or passed. This passive operation allows for minimal personnel. YN and/or WDFW will check the trap at least once a day.

Active operation follows the same procedures except that once fish move up the denil, a sampler is present to identify and decide which holding tank to send the fish into. During large salmon runs, it is necessary to actively trap Tumwater Dam so as not to overload the hopper/holding area. For non-trapping days, Tumwater Dam is opened for passage and a video monitoring system will record all migrating fish species.

In the Wenatchee subbasin, BDP1 is completed. During BDP2, Tumwater Dam trapping would occur up to 7 days a week, 16 hours a day from September through the middle of December, which is an increase from current practice (3 days a week, 16 hours a day). When YN is responsible for trap operations, Tumwater Dam will operate passively unless numbers warrant active trapping. During trap operations, YN personnel will check the trap at least once a day.

Leavenworth National Fish Hatchery

Leavenworth NFH volunteer ladder will be used for broodstock collection on Icicle Creek when available. This collection facility is owned and operated by USFWS. The hatchery ladder is located at RK 4.5 on the left bank shore directly below the hatchery pool. Broodstock enter here and migrate through a series of ladders until they enter one of two hatchery adult holding ponds. Fish enter the adult ponds through V-trap weirs, one located on each pond. However in most years the fish ladder and ponds are not available for broodstock collection, due to use for juvenile rearing. The LNFH volunteer ladder would operate 7 days a week, 24 hours a day beginning September through the middle of December.

Icicle Side Channel Trap(s)

Icicle Creek side channel collection would potentially occur at the Dam 5 structure and/or the headgate (Structure 2) located at the uppermost part of the side channel, at Leavenworth NFH. Trap design, weir configurations, and operations are in the initial phases of development but have not been finalized. If operations allow passive trapping, we would trap up to 7 days a week, 24 hours a day from September to the middle of December. Active and passive trapping schedule would need to be coordinated between all parties involved in Icicle Creek passage restoration.

Chiwawa Adult Weir Trap

The Chiwawa weir is located adjacent to the Chiwawa Acclimation Facility on the Chiwawa River (RK 2.0). This tributary trap will be important for future collection needs as coho releases are proposed for this basin. This weir spans the entire width of the river. The position of the weir is angled slightly to move migrating fish towards the right-bank shore. A holding facility is located on the right bank.

Chiwawa River adult weir trap would operate up to 7 days a week, 24 hours a day. The Chiwawa River trap would be operated passively with coho volunteering into the holding area. YN personnel will check the trap a minimum of once a day. Multiple checks per day would be warranted if large numbers of coho return to the Chiwawa in any given year. Trapping would begin in September and run through the middle of December.

Nason Creek Adult Weir Trap

The Nason Creek adult weir trap is a proposed, semi-permanent design that will be located on the lower kilometer of Nason Creek. The Nason Creek adult weir is being proposed/funded by Grant County PUD as a part of their mitigation obligations and would be operated by the YN. The trap is scheduled for operation by spring 2008. Early season trap operations will depend on WDFW scheduled needs for their supplementation programs. Preferred operations would be 7 days a week, 16 hours a day for active trapping from September to the middle of December. Annual broodstock protocols will provide specifics for bi-weekly collection goals and proportions collected from all the facilities. These protocols will be available by June 1 of every year.

White River Adult Weir Trap

The White River adult weir is another proposed, temporary trap that will be located somewhere in the lower two kilometers of the river. Exact weir location and operation is unknown at this time, but the trap may be operational by the NPIP. This weir will also be funded by Grant County PUD and would be operated by WDFW and YN. The design is for an actively operated weir for broodstock collection purposes.

6.1.2 Methow Subbasin

Wells Dam

Wells Dam is located at RK 829.6 on the Columbia River. This facility has been used by the MCCRP for broodstock collection due to difficulties of fulfilling broodstock goals within the Methow River subbasin. Unlike the Wenatchee River Basin, the Methow River does not have a lower basin trapping facility and must rely on a Columbia River mainstem location.

Wells Dam will be the primary collection facility during the BDP1. Wells Dam trap operations will be 7 days a week, up to 16 hours a day. Trapping duration will be from mid-September through mid-December. During BDP2, Wells collection will be modified to ensure that broodstock collection goals are met while allowing sufficient migration past the facility so that returning coho can be trapped at upstream locations. The proportion of Wells coho incorporated into the broodstock will depend on in-basin efforts. During the natural production phases, Wells Dam will continue to operate from September to the middle of December; the number of trapping days per week will be adjusted as necessary.

There are two trapping facilities at Wells Dam, the East and West fish ladders. All facilities are owned and maintained by DCPUD; the traps are operated by WDFW and YN. Both traps are positioned on exiting fish ladders. Fish ascend the west ladder and negotiate a chute where they are either shunted into a holding area at the Wells FH, or returned to the ladder. The fish that are shunted into the hatchery holding area are sorted at least once a week, depending on numbers in the holding pond. Fish using the east ladder trap ascend a series of pools to the trap. Fish negotiate a denil then pass down a chute where they are shunted to a holding container or returned to the ladder. Fish collected in the container are then placed in a transport truck for delivery to WNFH for holding. On non-trapping days, the trapping weirs are opened for fish passage.

Winthrop National Fish Hatchery

Winthrop NFH is located at RK 80.6 and is owned and operated by the USFWS. Fish volunteer into the hatchery's adult ponds through Spring Creek, a tributary to the Methow River. Coho collected at WNFH are held until spawning.

Supplemental trapping will occur at the WNFH volunteer ladder during BDP1 and BDP2. WNFH collections consist of coho volunteers into the hatchery adult holding ponds. Trap operation will be 7 days a week, 24 hours a day, mid-September to mid-December. During the natural production phases WNFH's volunteer ladder will be used only if additional hatchery fish are needed to ensure that broodstock collection goals are met.

Twisp River Adult Weir Trap

This adult weir trap is located at RK 6.4 on the Twisp River. This tributary trap will be important for providing additional broodstock within the basin.

Beginning with BDP2, trap operations will be 7 days a week, 16 hours a day beginning September to mid-December. Bi-weekly quotas will be provided in annual broodstock protocol documents by June 1. Shortfalls at this and other weir trap locations will require collection at Wells Dam.

The Twisp River weir is currently operated by WDFW. This floating weir is owned and maintained by DCPUD.

Chewuch River Adult Weir Trap

The Chewuch River weir trap is a proposed trap funded by DCPUD. It is currently undergoing feasibility evaluations. This facility would be operated by WDFW and YN.

Foghorn Dam

Foghorn Dam is a rock structure dam just above the Methow Valley Spring Chinook Supplementation Hatchery on the Methow mainstem has been ineffective at collecting spring chinook broodstock for other mitigation programs. Should improvements be made that allow more efficient trapping at the current right bank trap, then this location may be used for adult coho trapping.

6.2 Rearing Facilities

6.2.1 Rearing System and Site Alternatives

During the **broodstock development** phases, the mid-Columbia coho program proposes to use existing facilities for rearing. To help meet the objectives of the **natural production** phases, multiple alternatives for the rearing component of the project were evaluated. Guidelines were developed to select the basic types of systems and specific sites that would support the natural production phase rearing plan. See Appendix B.1.

The rearing environment in which fish are cultured is critical to meeting project goals. The availability of the correct amount and quality of reliable water supplies and the capability of sites to include effective rearing units are important requirements. Other siting guidelines involve construction and operating costs, the environmental impacts of construction and operation, the flexibility to meet changing needs, and operational considerations.

The different basic types of fish rearing system options evaluated were:

- Existing public hatcheries
- A new, large, central hatchery
- Several small rearing facilities located in the watersheds
- A central hatchery using constructed, natural habitat
- Extended rearing at acclimation sites
- Constructed habitat
- Combinations of the above.

Specific sites that could be used in these systems include existing Yakama Nation, USFWS, and Mitchell Act-funded hatcheries; existing acclimation sites with long-term rearing capability; and locations that require new development and construction.

These production systems and sites were compared and from them, a rearing plan proposed. It places heavy emphasis on using existing hatcheries due to cost considerations. Those hatcheries are Cascade Fish Hatchery and Willard National Fish Hatchery on the lower Columbia River and Winthrop National Fish Hatchery in the Methow subbasin. A new, small facility with only adult holding and incubation capabilities is proposed for the Wenatchee subbasin. Fry-to-smolt production in constructed habitats is proposed for a portion of the Methow releases. Summary descriptions of these facilities are in Sections 6.2.1 - 6.2.3, with details, including site drawings and additional photographs, in Appendices C.1 and C.2.

6.2.2 Lower Columbia River Rearing Facilities

Cascade Fish Hatchery

The mid-Columbia coho program proposes to produce pre-smolts from Cascade Fish Hatchery for the life of the program. The hatchery is operated by the Oregon Department of Fish and Wildlife (ODFW) on Eagle Creek, near Bonneville Dam. The numbers of fish destined for each subbasin change throughout the life of the program and are shown in Tables 6-1 and 6-2.

Cascade Fish Hatchery was authorized under the Mitchell Act and began operating in 1959 as part of the Columbia River Fisheries Development Program. The hatchery is supplied with surface water from Eagle Creek and has full rearing capability, with the following facilities (information from IHOT 1996):

- Adult holding: 1 concrete adult holding pond 22,500 cubic feet
- Incubation: Vertical stack incubators
- Raceways: 30 concrete raceways 16 feet by 78 feet by 2.5 feet deep; 3,120 cubic feet each.

The 2005 production goals were 700,000 coho for the mid-Columbia coho program, 1,000,000 coho for the Confederated Tribes of the Umatilla Nation, and 600,000 coho for the Clatsop Economic Development Commission. Water is supplied by gravity from Eagle Creek. The total water right is 20,200 gpm (45 cfs) with an actual average water usage of about 7,117 gpm (16 cfs). Typical Eagle Creek water temperatures fluctuate between 2° C in December/January to 17° C in July/August. High summer temperatures create some disease problems, but the large natural fluctuations may produce smolts that survive to adulthood in increased numbers (see Appendix A).

Fish will need to be trucked up to 250 miles to the upstream acclimation/release sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

The 2005 Mid-Columbia coho program reared 700,000 pre-smolts in 8 raceways, or 87,500 fish per rearing unit. Fish sizes for the March transport dates average 20/lb (4,375 lbs/raceway), resulting in volume densities in the raceways of 1.4 lbs per cft, typical for raceway culture but, due to space limitations, considerably higher than the MCCRP target value for new pond-based hatcheries (0.3 lbs per cubic foot).

Willard National Fish Hatchery

The mid-Columbia coho program proposes to produce pre-smolts from Willard NFH for the Wenatchee subbasin. The numbers of fish produced for the program changes throughout the life of the program and are shown in Table 6-1.

Willard NFH is located on the Little White Salmon River near Cook, Washington. It was authorized by the Mitchell Act in 1946 and constructed in 1952. The facility was originally planned as a fall chinook hatchery but changed to spring chinook and coho because of cold water temperatures, and then switched completely to coho in the mid-1960s. It operates on surface water and has full rearing capability, with the following facilities (information from IHOT 1997):

- Early rearing: 52 concrete starter tanks 91 cubic feet each
- Raceways: 50 concrete raceways 8 feet by 73 feet by 2.4 feet; 1,408 cubic feet each.
- 24 full stacks of vertical tray incubators (384 trays).

The 1997 hatchery production goal was 2,500,000 coho smolts, or 166,600 pounds. Current production is much lower and is focused on supporting tribal programs. In 2005, the hatchery reared 600,000 coho for the mid-Columbia program.

The hatchery is exempt from a National Pollutant Discharge Elimination System (NPDES) discharge permit because the effluent disappears into porous lava before reaching the Little White Salmon River. Cold water disease has been a problem in the past but is being controlled with improved fish culture techniques. Fish will need to be trucked up to 250 miles to the upstream release sites on the on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

The concrete raceways are narrow and shallow, which may have a negative impact on smolt quality (see Appendix A). The overhead covers are installed close to the water surface, providing effective shade. The general condition of the hatchery is good. A recent intake rebuild has improved water supply reliability.

6.2.3 Wenatchee Subbasin Rearing Facilities

For the duration of the program, project proponents propose to continue to rear coho at the existing Willard National Fish Hatchery and Cascade Fish Hatchery on the lower Columbia River (see Section 6.2.1), as shown in Table 6-1. However, due to the distance of these hatcheries from the Wenatchee subbasin, adult holding and early incubation will need to occur at other locations. Currently, Entiat NFH is being used for these functions; however, Entiat NFH is being considered for a programmatic change which would preclude continued use by the MCCRP during the fall.

Table 6-1. Wenatchee rearing locations and numbers

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
EXISTING HATCHER	RIES																				
Cascade	0.45	0.45	0.45	0.45	0.45	0.45	0.25	0.25	0.25	0.46	0.46	0.46	0.46	0.46	0.40	0.41	0.41	0.41	0.41	0.41	0.00
Willard	0.55	0.55	0.55	0.55	0.55	0.71	0.91	0.91	0.56	0.35	0.35	0.35	0.35	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	1.00	1.00	1.00	1.00	1.00	1.16	1.16	1.16	0.81	0.81	0.81	0.81	0.81	0.81	0.40	0.40	0.40	0.40	0.40	0.40	0.00

Adult Holding and Incubation Facility

A new, small adult holding and early incubation facility is proposed on the Wenatchee River. This facility would provide a centrally located site for handling the valuable local broodstock and incubation of eggs to the eyed stage.

The preferred location for this facility is near Dryden Dam at the mouth of Peshastin Creek. Ground water supplies would be developed to supply adult holding raceways and incubators. The site is in a location that would allow the development of rearing capacity with a surface water intake in the future, if required.

A site on the Chiwawa River immediately adjacent to the existing CCPUD Chiwawa Acclimation Pond is an alternative to Dryden. Dryden is the preferred option, however, because development risks, particularly land ownership, are somewhat lower than for Chiwawa. The Chiwawa site is discussed in detail in Appendix C.1.

Facility Requirements

- Site functions: The Dryden facility would perform limited functions. All captured local Wenatchee brood would be trucked to the proposed facility for holding and spawning. Eggs would be reared to the eyed stage, after which they would be moved to the two lower river facilities, Cascade FH and Willard NFH, for hatching and early rearing.
- Production numbers: 1,300 adults and 1,300,000 eyed eggs.
- Development timing: Current plans call for hatchery construction to start during the second quarter of 2008, testing to occur in 2009, and operation to begin in 2010.

Site Information

- Location, elevation: Near the mouth of Peshastin Creek; in T24N, R18E, SW ¼ of S22 in Chelan County; adjacent to Dryden Dam; elevation 980 feet.
- Tributary of: The Wenatchee at river mile 18.
- Ownership: The 8.5-acre Washington State Department of Transportation (WSDOT) property (Figure 6-1) is lot number 241822745006, zoned Commercial Agricultural Lands (AC). The 15.5-acre Willow Springs Orchards property (Figure 6-1) is lot number 241822745055, zoned Rural Residential /Resource (RR2.5).
- Geotechnical conditions: Soils are likely AASHTO classifications A-1 to A-2.
- Critical areas designation: Unknown.
- Flood designation: Zone X500 (between 100 and 500 year floods). The proposed site sits on a bench that is 20 to 40 feet above the Peshastin Creek delta. Construction in this area will allow the hatchery to sit above the 100-year flood elevation without placing fill in the floodplain.
- Current land use: The proposed hatchery site is an orchard; the proposed infiltration gallery area is used by WSDOT for storage of highway sand.
- Access: Plowed, paved roads.
- Utilities: 3-phase power is available at the nearby Dryden right bank ladder facility; telephone lines at the road could be brought into the facility.
- Trucking distances: Approximately 40 miles from the upstream acclimation sites on the White, Chiwawa, and Little Wenatchee rivers and Nason Creek.

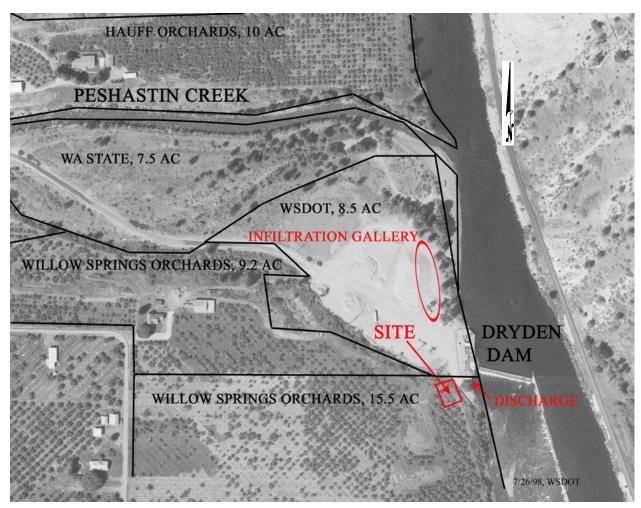


Figure 6-1. Site of Proposed Dryden Adult Holding and Incubation Facility

Water Supply

- Groundwater availability: The geology of the site suggests productive groundwater conditions. Historic gravel deposition at the Peshastin alluvial fan may have left thick layers of clean gravel.
- Groundwater withdrawal. An infiltration gallery is proposed, although deeper well water may also be available.
- Flood levels: The area where an infiltration gallery is proposed is within the 100-year flood boundaries; the facility site is above it.
- Groundwater temperature: Unknown, likely close to the average annual air temperature in the area, 48° F at Dryden (data from the Western Regional Climate Center).

Proposed Design

Site plans are shown in Appendix C.1. The following summarizes design characteristics.

- Water supply: Water from the infiltration gallery would be piped to the facility site, then run through a packed column to put it into gas equilibrium with air.
- Adult holding: 3 concrete raceways (the 2 required plus a back-up), will be available for holding adults. Multiple divisions in the raceways will allow fish at different levels of development to be held separately.
- Incubation: 10 vertical stack incubators will be capable of incubating 1,300,000 coho eggs.
- Water discharge: Return of water to the Wenatchee is proposed at the Dryden right bank ladder entrance to improve attraction for returning fish.
- Predator control, cover: The site will be fenced and an overhead net system will be installed.
- Waste treatment: Adults will not be fed so raceway discharge will not be treated. Incubation effluent will require formalin removal, which would be done in the facility building.
- Facility size: The proposed layout requires 19,000 square feet (0.4 acres) of land.

Environmental Issues

- Listed species: Bull trout, steelhead, and spring chinook migrate through the Wenatchee River but would not be adversely affected by the facility. The water intakes from the Wenatchee and Peshastin Creek would meet NMFS screening and design criteria for listed fish (NMFS 2004).
- Floodplains: The facility structures will be outside the 100-year floodplain and the infiltration gallery will be below grade, resulting in no net impact to flood storage capacity.
- Water rights: Due to the presence of a large number of wells in the area and the potential large hatchery withdrawals, well operation may affect surrounding property owners. An infiltration gallery would have less impact on deeper aquifers because it draws water from a surface aquifer that is recharged by surface water. Hydrologic impacts on flow in Peshastin Creek are possible and will need to be evaluated.
- Other fish operations: Other fish operations upstream of the proposed site will not likely impact operation of this coho facility. The only fish facility in the vicinity is Chelan PUD's Dryden Summer Chinook Acclimation Pond, which is located across the Wenatchee River (left bank) and downstream a half mile. However, the water intake for this acclimation pond is upriver of the proposed Dryden site, and the summer chinook acclimation facility is not used during the months the proposed facility would be used, so discharge from the proposed facility would not impact the PUD acclimation pond.

Development Risks

- Groundwater availability: Lack of groundwater would prevent development of the site; however, geologic conditions (see above) are favorable for groundwater development.
- Water quality: Use of agricultural chemicals in nearby farmland could adversely affect water quality at the proposed facility.

- Other permits: Because the required environmental processes would not be completed until
 later phases of the decision-making process, risks exist of not being able to obtain some of
 these required permits. Risks include local property owner opposition. Farmers may be
 threatened by fish restoration projects in general if they believe that their irrigation water
 rights will be reduced because of minimum instream flow requirements for fish.
- Land availability: Negotiations with the private land owners for use of the hatchery property, with Chelan PUD for construction near the Dryden ladder, and with WSDOT for use of land for infiltration gallery construction would not be conducted until later phases of the decision-making process; therefore, availability of these properties is not yet known.

6.2.4 Methow Subbasin

In the Methow subbasin, the program proposes to rear coho at the existing Cascade and Winthrop hatcheries and at two constructed habitats. The total reared per year at the hatcheries for Methow release is shown in Table 6-2. Detailed plans are described in Appendix C.2.

Table 6-2.	Methow	rearing	locations	and	numbers
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						—														
2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
RIES																				
0.25	0.25	0.25	0.25	0.25	0.25	0.45	0.45	0.45	0.24	0.24	0.24	0.24	0.24	0.24	0.00	0.00	0.00	0.00	0.00	0.00
0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
SITAT	S																			
τ	\Box		\Box	\Box	$\overline{}$	0.20	0.20	0.20	0.14	0.14	0.14	0.14	0.14	0.14	0.07	0.07	0.07	0.07	0.07	0.07
i	\Box		\Box	\Box	i	0.10	0.10	0.10	0.07	0.07	0.07	0.07	0.07	0.07	0.04	0.04	0.04	0.04	0.04	0.04
0.50	0.50	0.50	0.50	0.50	0.50	1.00	1.00	1.00	0.70	0.70	0.70	0.70	0.70	0.70	0.35	0.35	0.35	0.35	0.35	0.35
	0.25 0.25 BITAT	0.25 0.25 0.25 0.25 0.25 0.25 BITATS	0.25 0.25	0.25 0.25	RIES 0.25 0.	RIES	NES	NES	RIES											

Constructed Habitats

The basic principles of the constructed habitats are described in Appendix B.1 Rearing Facilities Alternatives and in the literature (Smith et al. 2004). They consist of pools, runs, riffles, alcoves, and ponds (see Figure 6-2) and include woody debris and overhead cover. Constructed habitat is a rearing environment that mimics natural conditions.

The program proposes to use Winthrop NFH to hold all adults that return to Methow constructed habitats, to incubate their eggs and rear them to fingerling size. Fingerlings are moved to the habitats after tagging in June. They are reared in the habitats to smolt size and released in April. Migrations out of the habitat will be prevented until fish are fully smolted. Exit fish screens will be maintained throughout the 10-month production cycle. These habitats function as both rearing and acclimation/release sites.

Predation control will be an important feature of the habitats. Fences will be used where possible and heavy tree cover will limit access by birds with long landing flight paths such as mergansers. Other bird predation will be controlled by deterrence through human presence, a technique that has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries.

Natural foods (aquatic insects and macro-invertebrates) will be produced in the habitats, but the mass is not expected to be enough to meet nutritional demands. Therefore, supplemental hatchery fish food will be provided.

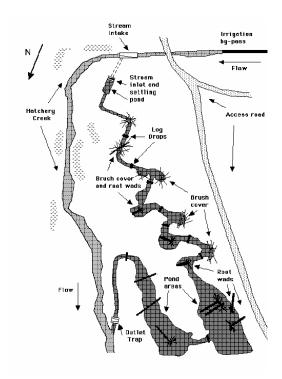


Figure 6-2. Typical Constructed Habitat

(from Smith et al. 2004)

Eightmile Constructed Habitat

A potential constructed habitat site has been identified near the mouth of Eightmile Creek, a tributary of the Chewuch River, on USFS property at Eightmile Ranch (Figure 6-3). A combination of surface water from Eightmile Creek and well water is proposed for the water supply.

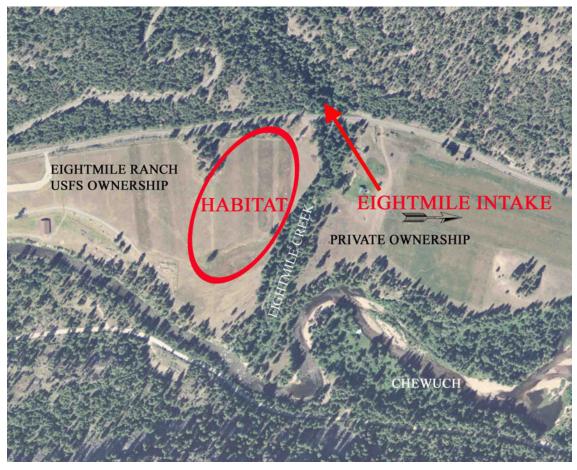


Figure 6-3. Eightmile Constructed Habitat Location

Facility Requirements

- Fish numbers: 200,000 are proposed.
- Water and space programming: Space requirements have been developed through experience with a test site on the Dungeness River (Smith et al. 2004). Minimum water flow rates are determined using standard hatchery procedures (Piper et al. 1982). Higher water flows may be used to provide additional hydraulic complexity. Appendix C.2 details water and space needs at assumed water temperatures.
- Land requirement: Assuming that the water surface area takes up 33% of the site, 15 acres of land are required.
- Development timing: Current plans call for releases to begin as early as 2010. Construction and testing would then need to be completed by the summer of 2009.

Site Information

- Location, elevation: Near the mouth of Eightmile Creek; in T36N, R21E, SE ¼ of S23 in Okanogan County; elevation 2,100 feet.
- Tributary of: The Chewuch at river mile 11.
- Ownership: USFS. .
- Geotechnical conditions: Site development is not limited by physical terrain characteristics. Soils are likely AASHTO classifications A-1 to A-2.
- Zoning: None.
- Shoreline designation: None.
- Comprehensive plan designation: USFS.
- Flood designation: Out of flood hazard zones.
- Wetlands designation: none
- Current land use: Pasture.
- Access: Plowed, paved roads.
- Expansion capability: Land may be available for expansion.

Water Supplies

- Surface water flow: The site has two potential surface water sources, an abandoned irrigation intake on Eightmile Creek and existing wells on the Eightmile Ranch. The proposed peak withdrawal of 6.5 cfs in September would result in about half the flow being removed from the creek between the intake and discharge location (see Appendix C2. Table 2).
- Surface water temperature: Data is not available but will be collected.
- Surface water quality: Excellent due to the undeveloped nature of the watershed.
- Icing potential: High for Eightmile Creek; groundwater pumped to the intake will reduce icing problems.
- Flood levels: Above flood elevations
- Groundwater availability: The USFS has developed a well field on the Eightmile Ranch property for irrigation. Two new production wells were constructed and one existing well was reconditioned in 2002. Pump test results show potential yields of up to a total of 875 gpm. The availability of part of this capacity for operation of the constructed habitat has not yet been discussed or evaluated with stakeholders (USFS, Washington Dept. of Ecology, and irrigators). One new well is proposed for the location that will be dedicated to the habitat operation and potentially to mitigate impacts of surface water withdrawal.
- Groundwater temperature: Unknown but will be determined in the future.

Proposed Design

- The habitat will require approximately 10 acres of water surface area in a variety of sizes and shapes.
- Construction will involve balancing cut and fill. Material excavated to form the water environments will be used to construct the surrounding land areas. No fill will be removed from the site.
- Surface water for the habitat will be withdrawn from the abandoned irrigation intake upstream of the road culvert (see details in Appendix C.2). To reduce the impact of this withdrawal from Eightmile Creek, water will be pumped from the discharge of the habitat up to a point close the intake during low flow periods.
- Ground water from the existing and new wells will be used in the winter to add water supply security and to reduce icing conditions on the intake. It will also be used in the summer to reduce discharge water temperatures.
- Tree, brush, and grass plantings will provide shade and stabilize habitat shorelines.
 Large, woody debris will be hauled to the site and strategically placed throughout the system.
- The discharge channel will be constructed with log sills to allow passage of adults into spawning areas below the habitat.
- Outlet structures will prevent premature downstream movement and will include fish counters to enumerate migration.

Environmental Issues

- Listed species: The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checker-mallow, and Ute ladies'-tresses habitat. Bull trout, steelhead, and spring chinook exist in the Chewuch River. Steelhead and bull trout use the lower section of Eightmile Creek.
- Water rights: Withdrawal of surface water from a section of Eightmile Creek has potential impacts on migration conditions for area fish. Passage improvements in Eightmile Creek may be necessary to mitigate for changed flow conditions. This could entail strategically placing or rearranging boulders and woody debris and adding rock filled gabions to establish reliable flows for passage.
- Water temperature: Increasing the retention time of Eightmile Creek water by holding it in a constructed habitat will increase water temperatures in the summer. However, groundwater from wells will be added to the habitat to reduce temperature impacts.

Development Risks

- Water rights: Obtaining the rights to withdraw water from Eightmile Creek and changing the period of use of the groundwater may be issues.
- Land availability: Negotiations with the USFS for use of the property have not been conducted. The development of a constructed habitat would reduce the pasture land available for Eightmile Ranch.

• Local opposition: The reintroduction of coho into the Methow and construction of a habitat at Eightmile may be opposed by local citizens for a variety of reasons, which will be addressed during NEPA scoping and document reviews.

Heath Ranch Constructed Habitat

A potential constructed habitat site has been identified on the Heath Ranch, with a very small portion of the continuous waterway at the southern boundary of Big Valley Ranch, in the Methow watershed. Existing spring water is the proposed water source. Much of the habitat currently exists and is planned to be used by this project.

Facility Requirements

- Fish numbers: A 100,000 smolt release is proposed for this site.
- Water and space programming: Space requirements have been developed through experience with a test site on the Dungeness River (Smith et al. 2004). Minimum water flow rates are determined using standard hatchery procedures (Piper et al. 1982). Higher water flows may be used to provide additional hydraulic complexity. Appendix C.2 details water and space needs at assumed water temperatures.
- Development timing: Current plans call for releases to begin as early as 2013. Construction and testing would then need to be completed by the summer of 2012.

Site Information

- Location, elevation: T35N, R21E, SE ¼ of S30 in Okanogan County; elevation 1,800 feet
- Tributary of: The Methow at river mile 54.
- Ownership: Big Valley Ranch WDFW; Heath Ranch private.
- Zoning: Rural Residential.
- Shoreline designation: Rural Development.
- Comprehensive plan designation: Big Valley Ranch state land; Heath Ranch agricultural.
- Wetlands designation: Palustrine in the National Wetlands Inventory.
- Current land use: Wildlife management, recreation.
- Access: Plowed, paved road (Hwy 20) to within 1,000 feet of the site, gravel road access road
- Expansion capability: Land may be available for expansion.
- Trucking distances: None.

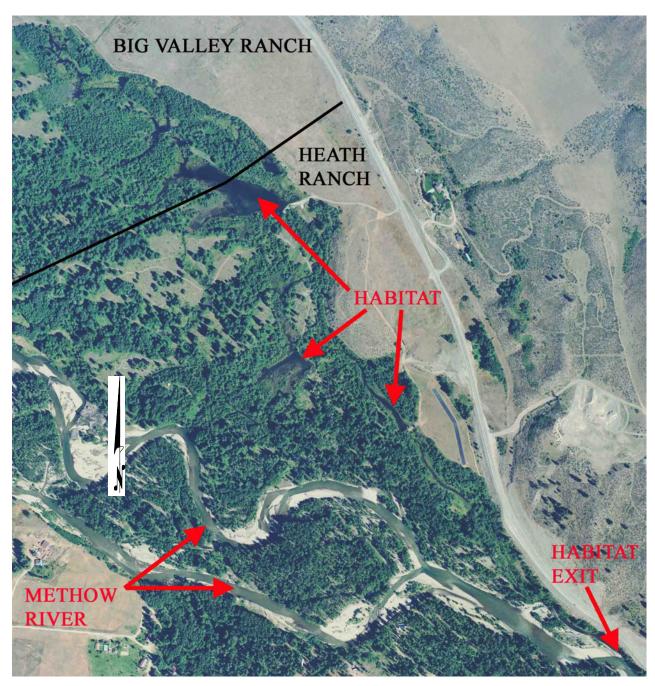


Figure 6-4. Heath Ranch Constructed Habitat Location

Water Supplies

- Water flow: Flows have not been measured but will be in the future.
- Water temperature: Data not available but will be collected in the future.
- Surface water quality: Likely excellent.
- Icing potential: Low.
- Flood levels: The site is within the 100-year flood elevation boundary.

Proposed Design

- Spring water flows through the series of ponds and wetlands. Additional water supply development is not planned.
- The spring channel is 1.5 miles long. To have the required 200,000 square feet of water surface area, the spring channel needs to average over 3 feet in width, which is the case. A detailed survey will allow a more precise estimate of surface area. Some minor construction may be planned to improve habitat conditions. Access to the habitat by migratory fish may not be possible now (Bob Jateff, WDFW biologist, personal communication, 2005), so barriers may need to be removed.
- Fencing may not be possible on the Big Valley section of the habitat due to WDFW wildlife management preferences (open range). Though optimal, fencing is not necessary for meeting the site's objectives for producing quality coho smolts. Other predation reduction options could include human presence for extended periods of time and/or using only the portion of the habitat that is on Heath property where fencing may be allowed
- A downstream fish barrier would be constructed to prevent early migration of coho out of the system. The barrier will also include fish counting systems.

Environmental Issues

- The area is potential wolf, lynx, grizzly bear, bald eagle, spotted owl, Nelsons checkermallow, and Ute ladies'-tresses habitat. Bull trout, steelhead, and spring chinook exist in the Methow River. Listed and other fish species currently do not have access to this off channel habitat. This project would link it to the river, making the habitat accessible when channel outlet traps and intake screens are removed after release of the coho smolts. Some non-target species may residualize until the next brood year of coho is introduced, but this could benefit those fish by increasing prey density and by providing supplemental feed.
- Impacts to wildlife on the Big Valley Ranch from site operation must be minimized. Disturbances from construction and/or operation will need to be controlled to meet wildlife management objectives.

Development Risks

- Land availability: Negotiations with the WDFW and the private land owners for use of the property have not been conducted.
- Local opposition: The reintroduction of coho into the Methow may be opposed by local citizens for a variety of reasons.

Winthrop National Fish Hatchery

The proposed plan calls for the continued production of 250,000 pre-smolts from the Winthrop NFH. Starting with Broodstock Development Phase 2 (BDP2), only part of this production will continue to be released on station. The removal of fish prior to reaching full smolt size will reduce hatchery loadings.

Plans also call for Winthrop NFH to hold all captured Methow broodstock. With minor modifications of less than \$5,000 to the water delivery system, adult holding area, and incubation system, this facility will hold the 1,300 adults (600 gpm and 5,000 cft of adult holding water volume), and incubate up to the eyed stage, the 1,300,000 eggs that this plan requires.

Winthrop NFH was originally authorized as part of the Grand Coulee Fish Maintenance Project. It began operation in 1942 to compensate for fish losses in the upper Columbia River drainage caused by the construction of Grand Coulee Dam. The funding agency is the U.S. Bureau of Reclamation and the operating agency is the U.S. Fish and Wildlife Service.

The following information is from Integrated Hatchery Operations Team (IHOT) 1998 and the 2002 HGMP (YN et al. 2002) and represents current conditions at the hatchery. The hatchery has water rights totaling 29,930 gpm from the Methow River, Spring Branch Spring, and two infiltration galleries (6,000 gpm total capacity). Water use ranges from 8,528 to 27,686 gpm, with the Methow River providing the majority of the flow. Rearing systems include:

Adult Holding Ponds: 2 concrete ponds at 25,000 cft each that are not currently being used.

Incubation: 150 iso buckets and 150 vertical stack trays.

Early Rearing Tanks: 34 fiberglass, 16 feet x 2 feet x 2.8 feet.

Raceways: 30 at 80 feet x 8 feet x 2.3 feet — 1,470 cft each (design flow of 300 gpm).

Raceways: 7 at 100 feet x 12 feet x 1.8 feet — 2,200 cft each (design flow of 350 gpm).

Foster-Lucas Ponds: 7 at 2,750 cft each (design flow of 350 gpm).

6.3 Acclimation Facilities

The primary objective of the acclimation plan is to produce quality smolts that return as adults in high numbers to habitat areas that will support natural production. The impact of acclimation systems on overall adult survival rates; return rates to natural production areas; capital and operating costs; flexibility to adapt to changing release numbers, locations, and methods; and site development considerations helped determine the program design. Guidelines based on these elements were used to evaluate both general types of acclimation system alternatives and specific sites that comprise those systems.

To develop the conceptual design proposed in this master plan, multiple alternatives for the acclimation component of the project were evaluated; the alternatives and a proposed plan are described in detail in Appendix B.2.

Acclimation options evaluated in Appendix B.2 are:

- Length of acclimation period.
- Number of release locations.
- Location of sites within watershed.
- Type of water supplies.
- Design of acclimation rearing systems.

A comparison of these options based on the selection guidelines demonstrates that a program based on multiple, low density, natural ponds fed by gravity flow surface water is the most cost effective system that meets program objectives. The proposed program emphasizes these sites while also including other designs dictated by practical, watershed-dependant considerations.

The proposed acclimation system has one or more release sites in each of the tributary streams that are targeted for reintroduction. A total of 18 release sites are proposed in the Wenatchee and Methow watersheds. Eleven of these sites exist now and do not require significant amounts of construction (6 of the 11 are currently being used by the MCCRP). Of the remaining 7 sitess that require construction, 2 will be used for rearing as well as acclimation and release.

The proposed acclimation plan is based on an innovative system of multiple low-cost, natural sites located near coho habitat. Although this technique is not in widespread use, it has been well tested during the feasibility phase of the Mid-Columbia and Yakima coho projects.

This acclimation system is expected to produce high adult return rates, spread fish into appropriate habitat, and have low overall project costs. It will also have the flexibility to adapt to planned and unplanned changes in program release protocols.

6.3.2 Wenatchee Subbasin

Smolts are proposed to be released from a total of 9 locations in the Wenatchee watershed. Six of these sites currently exist and 3 require substantial amounts of construction. Most of the proposed acclimation sites in the Wenatchee subbasin have been used in the past by the MCCRP. Figure 6-6 shows the locations of the sites that form the proposed plan for the Wenatchee. Conceptual designs and photographs of the sites are shown in Appendix C.3.

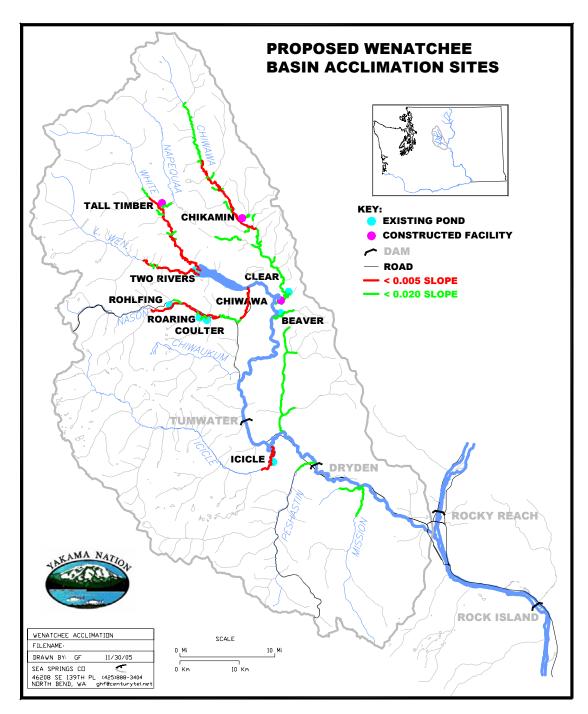


Figure 6-5. Proposed Wenatchee Subbasin Acclimation Sites

Many factors can result in a preferred location not being available for use. In all the watersheds, alternatives to the proposed sites discussed below have been identified and are listed in Appendix B.2.

Site descriptions

General information

Information about the location of the sites, their purpose, their type, their accessibility, and the presence of utilities is summarized in Table 6-3. In the location section, the tributary column lists the stream into which the acclimation ponds drain. River miles and elevation give a rough indication of the migratory difficulty for each proposed site.

The purpose section of the table provides some information about the proximity to habitat and about the main purpose of the site. Some locations function to release smolts so that returning adults are imprinted on spawning habitat located near the release site, some sites are used mainly for broodstock development (with adults returning to downstream locations), and some sites are intended to distribute adults widely within the targeted stream. The slope data (for the approximately one mile of stream below the release point) is a rough approximation of the quality of nearby habitat. Slopes less than 0.5% have been identified on watershed maps as approximating low-gradient habitat.

The site type section indicates whether ponds currently exist or must be constructed and the type of facility proposed. The site type section also lists whether the locations have reasonable potential for over-winter acclimation. In all of the following tables, the sites in red typeface require significant amounts of construction. This includes the construction of ponds and pumped water supply systems at Tall Timber, ponds and a gravity water intake at Chikamin, and construction of both ponds at Chiwawa.

Table 6-3. Wenatchee acclimation site general information

	LOCATION								PUF	RPOS	E		SI	TE TY	/PE		OTHER		
	MAIN TRIBUTARY	RIVER MI. TO MOUTH OF WEN.	TOWNSHIP	RANGE	SECTION	1/4 SECTION	ELEVATION	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE ADULT DISTRIBUTION	DOWNSTREAM SLOPE (%)	WINTER USE	EXISTING NATURAL POND	EXISTING MANMADE POND	CONSTRUCTED POND	CONSTRUCTED FACILITY	PLOWED ACCESS	UTILITIES	
Rohlfing	Nason	68	26	16	5	NE	2,240			√	0.29	√		√			√	\checkmark	
Coulter/Roaring	Nason	64	26	16	11	SE	2,170	√			0.32		√				√	√	
Tall Timber	White	70	28	16	18	SW	1,930			√	0.21	√				√	√	√	
Beaver	Wenatchee	47	26	17	12	NE	1,900	√	√		1.33			√			√		
Chikamin	Chikamin	62	28	17	21	SW	2,400	>			0.12				✓				
Clear	Chiwawa	50	27	18	31	NE	2,000			√	0.85	√		√			√	\checkmark	
Chiwawa	Chiwawa	48	27	17	36	SE	1,860			>	0.90	√				√	√	√	
Two Rivers	L. Wen.	60	27	16	21	SW	1,880			✓	0.16	√		√			\checkmark	√	

Water and Space

Minimum water requirements were calculated based on a flow density of 6 pounds of fish per gallon/minute of flow, with an average release size of 18 fish per pound (see Appendix A Fish Culture Guidelines, for more detail and references). This is an average minimum value based on approximate spring-time water temperatures and assumes saturated inflow; however, rflow rates should be higher to provide a safety margin; the amount of margin depends on the reliability of the water supply at each site. Space requirements were calculated using 0.3 pounds of fish per cubic foot of water at sites with 24 hour security and 0.1 lbs/cft at all other sites. The land requirement assumes that the water surface covers half of the site.

Table 6-4 describes the water source and provides some flow data. These are preliminary measurements; more flow data will be collected. In general, locations that have either gravity or pumped ground water supplies are capable of operating through the winter. Sites with intakes require a high degree of security.

Table 6-4. Wenatchee acclimation site water and space requirements

				REQUIRE	MENTS						SPACE						
	PROPOSED RELEASE NUMBER	CURRENT CAPACITY	WATER NEEDED (CFS)	REARING SPACE RQRT (CFT)	WATER SURFACE RQRT (ACRES)	Number of Ponds	POND LENGTH	POND WIDTH	LAND SURFACE RQRT (ACRES)	WATER SOURCE	APRIL FLOW (CFS)	GRAVITY, GROUND	GRAVITY, SURFACE	INTAKE REQUIRED	PUMPED, GROUND	PUMPED SURFACE	CURRENT POND SIZE (CFT)
Rohlfing	105,000	105,000	2.2	19,000	0.1					Unnamed			✓		✓		36,000
Coulter/Roaring	105,000	200,000	2.2	19,000	0.1					Coulter			√				32,400
Tall Timber	210,000		4.3	39,000	0.3	2.0	139.6	46.5	0.6	Napeequa				✓		<	
Beaver	100,000	75,000	2.1	19,000	0.1					Beaver	2.0		√	✓			25,120
Chikamin	100,000		2.1	19,000	0.1	1.0	137.8	45.9	0.3	Minnow	30.0		✓	<			
Clear	170,000	170,000	3.5	31,000	0.2					Clear	2.0	√					NA
Chiwawa	170,000		3.5	31,000	0.2	2.0	124.5	41.5	0.5	Chiwawa	Large					✓	
Two Rivers	120,000	120,000	2.5	22,000	0.2					Lake	1.3				✓	√	30,000

Environmental Conditions

Table 6-5 shows land use designations, ESA-listed fish species that might be near the sites, and other potential development risks for proposed Wenatchee basin sites. These and other impacts will be evaluated in more detail during permit and decision processes, including the NEPA analysis.

Chelan County zoning designations are defined as follows: RR5, rural residential with a limit of one dwelling per 5 acres; RR10, rural residential with a limit of one dwelling per 10 acres; RR20, rural residential with a limit of one dwelling per 20 acres; RRR, rural residential recreational; and FC, commercial forest. Flood designations have the following meanings: X500 is between the 100-year and 500-year flood elevations; A is within the 100-year floodplain and possibly in a floodway; and X is out of the floodplain.

Check marks under the species listed in the Environmental Impacts column indicate that they are likely to be present near the intake or pond. The main impacts to listed fish are barriers or

intakes which impede migration around or through acclimation sites. Site designs aim to minimize these impacts.

Development risks list some of the major issues that may prevent construction and/or operation of the sites and affect the facility development process. They include: local opposition during construction permit application; low flow volumes; water rights issues; waste discharge addressed through the NPDES process; the availability (lease, purchase, or use agreement) of land and access. A check mark in these columns means that preliminary analysis indicates the issue might be a problem at that site.

Table 6 5	Wonatchoo	acclimation	ite environment	tal conditions
l able 6-5.	vvenatchee	accilmation s	ite environmeni	ial conditions

			LAND USE		ΕN	IV. IN	1PAC	TS		[DEV. I	RISK	S	
	SONING	FLOOD DESIGNATION	LAND USE	OWNERSHIP	MINIMAL FISH IMPACTS	BULL TROUT LIKELY	STEELHEAD LIKELY	SPRING CHINOOK LIKELY	LOCAL OPPOSITION	FLOW QUANTITIES	WATER RIGHTS	DISCHARGE IMPACTS	LAND OWNERSHIP	ACCESS
Rohlfing	RR5	Х	Rural residential	Private		√	√			√		√		
Coulter/Roaring	RR5	Х	Rural residential	Private		√	√					√		
Tall Timber	RR20	X	Guest ranch	Private	√				√		√		✓	
Beaver	RR5	Х	Guest ranch	Private			√			✓		√		
Chikamin	FC	X	Private forestry	Private		√	√	√		√		√	✓	√
Clear	RRR	Х	Private campground	Private	√					√		\	✓	
Chiwawa	RR20		Acclimation	Public	✓						✓		✓	
Two Rivers	RR20	Α	Gravel mine	Private	√								✓	

Additional Site Information

Water effluent treatment systems that are separate from acclimation ponds are not planned. Relatively small numbers of fish will be held at low densities in large ponds. The minimum retention time for water flowing through the pond will be 2.5 hours and in most cases will be several times longer than this. Fish wastes will settle at low densities in the ponds and will be effectively treated during the long periods of time through the summer and fall when coho are not being acclimated. Most acclimation ponds developed for other species in the region do not include off-line effluent treatment systems.

Avian and mammalian predation is a major consideration for remote acclimation sites. At some locations, chain link fences and overhead bird netting will be installed. At other sites, electric fences and overhead wires could be used. Deterrence of predation through human presence has been used effectively at sites currently operated by the MCCRP as well as at federal and state hatcheries and will be employed at locations where no structures are possible.

Many of the ponds at proposed sites could become inundated during floods, which can occur in the spring during coho acclimation/migration periods. For that reason, the program will not prevent the unplanned release of fish due to flooding.

Existing Sites

- Rohlfing. This site is currently being used by the MCCRP. The recent addition of a well will allow it to be used for over-winter acclimation. Low flows in this intermittent stream that supplies surface water limit the number of fish that can be acclimated. Installation of fencing has been approved by the landowner to reduce predation. The site is located near the upstream end of accessible habitat on Nason Creek.
- Coulter/Roaring. These sites are very close together and will be managed as one. Coulter is a beaver pond that is currently being used by the MCCRP. The Roaring wetland complex (much of which is owned by Yakama Nation) has several large beaver ponds that can be used for acclimation. Fish released from Coulter pond will migrate through the Roaring wetland complex to reach Nason Creek. Steelhead are known to migrate through the complex and to spawn in Roaring Creek. Net enclosures for coho in the beaver ponds would allow the free passage of other species through the system. These sites will introduce smolts into one of the important habitat areas of Nason Creek.
- Beaver. This site is currently being used by the MCCRP. The pond has an existing intake that allows free passage of migrants throughout Beaver Creek while coho are acclimating. Bird predation is limited to some extent by the surrounding tree cover, but otters are present. Beaver Creek has similar habitat attributes as many streams used by coastal coho salmon; however, to date it has seen limited spawning activity. Use may be limited by obstructions to migration including culverts and an irrigation diversion. Improvements to migration will be addressed during the habitat improvement phase of the proposed reintroduction program.
- Clear. This pond is on property owned by a private campground. Owners have been approached in the past about coho acclimation and have been receptive. The large pond volume and secure water supply will allow large numbers of fish to be acclimated through the winter. An acclimation site on Clear Creek would introduce smolts into the lower Chiwawa, downstream of low-gradient, high-quality habitat.
- Two Rivers. This site previously has been used by the MCCRP. Water was pumped from a lake formed by a gravel mine operation to an existing pond. Gravel excavation through the winter and spring creates relatively high turbidity in the lake. To minimize sediment discharge, water was returned to the lake rather than to the Little Wenatchee River. The site introduces coho into the lower section of the Little Wenatchee.

New Facilities

• *Tall Timber*. There are no accessible, existing ponds on the White that can be used for acclimation and few tributary streams that would allow gravity fed ponds to be constructed. For this reason, a conventional pumped water acclimation site is proposed. The proposed location is in the upper part of the low-gradient section of the White River. Plans are to drill a well and to construct a surface

water intake and two ponds. Groundwater from the well will be spread over the river water intake to reduce icing impacts and allow use of the site through the winter. Predation control will include fences and overhead nets. The operation of a pumped surface water intake will require effective alarm systems and 24-hour security. Recent attempts to build a spring chinook acclimation facility on the site have been met with public opposition. We believe the coho project may be more acceptable because the purpose is reintroduction rather than supplementation of an existing population, and because the proposed facility will be temporary.

- Chikamin. An existing pond on private property exists where Minnow Creek enters the Chikamin, a tributary of the Chiwawa. The pond is likely important habitat for other species and is not large enough to segregate with net enclosures. As a result, an off-channel pond is proposed for construction near the mouth of Minnow Creek, on land to be purchased. Water from a gravity flow intake on Chikamin would feed the ponds. The Chikamin itself, and the low-gradient section of the Chiwawa where it enters, are likely high-quality coho habitat.
- Chiwawa. Construction of an earthen pond adjacent to the Chiwawa Spring Chinook Acclimation Facility is proposed. Second-use water from the facility would supply the coho pond. No new water systems are constructed, and it is assumed that land would not need to be purchased. Over-winter operation, good site security and predation control will be possible. The site reintroduces smolts into the lower section of the Chiwawa.

6.3.3 Methow Subbasin

Smolts are proposed to be released from a total of nine locations in the Methow watershed (Figure 6-6). Three of these are also rearing sites: the Winthrop NFH; the Eightmile constructed habitat; and the Heath constructed habitat. These sites are described in detail in Section 6.2 Rearing Facilities. Of the remaining six, five have existing ponds that can be used. Two of the six sites require substantial amounts of construction. Alternatives to the proposed sites are listed in Appendix B.2.

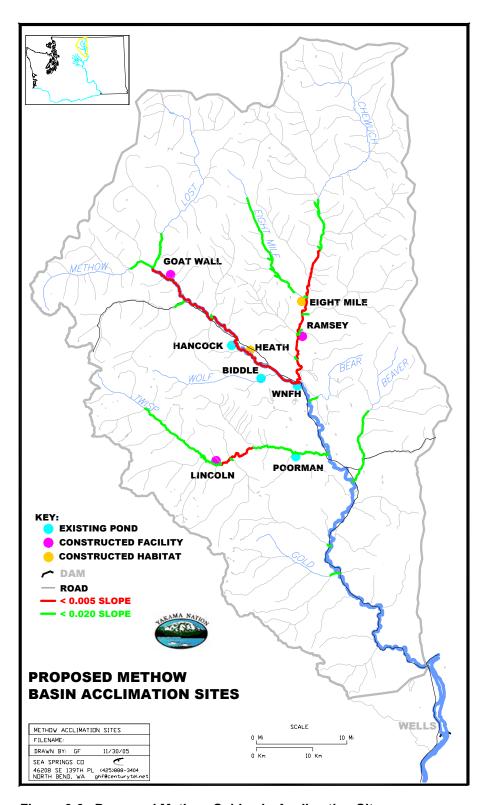


Figure 6-6. Proposed Methow Subbasin Acclimation Sites

Site Descriptions

General Information

Information about the location of the sites, their purpose, their type, their accessibility, and the presence of utilities is summarized in Table 6-6. The categories in the table are the same as for Table 6-3. In all the following tables, the sites in red typeface require significant amounts of construction, including construction of ponds and water supply systems at Lincoln and construction of both ponds and water systems at Goat Wall.

Table 6-6. Methow acclimation site general information

		LO	CATIO	ON				PUF	RPOS	Ε		SI	ΓΕ ΤΥ	Έ		OTH	HER
	MAIN TRIBUTARY	RM TO MOUTH OF METHOW	TOWNSHIP	RANGE	SECTION	ELEVATION	LOCAL SPAWNING	BROOD DEVELOPMENT	WIDE ADULT DISTRIBUTION	DOWNSTREAM SLOPE (%)	WINTER USE	EXISTING NATURAL POND	EXISTING MANMADE POND	CONSTRUCTED POND	CONSTRUCTED HABITAT	PLOWED ACCESS	UTILITIES
Ramsey	Chewuck	57	35	21	11	1930			✓	0.57			√			✓	√
Poorman	Twisp	44	33	21	10	1730			√	0.67	√		√			\checkmark	\checkmark
Lincoln	Twisp	56	33	20	16	2310	√		√	0.57	√	√				✓	✓
Biddle	Wolf	54	35	21	32	1920	√	√		2.40			√			√	√
Hancock	Methow	59	35	20	15	1920	√		√	0.49	√	√				√	
Goat Wall	Methow	68	34	17	7	2258	>		√	2.25	√	√				✓	

Water and Space

Water and space requirements were calculated as described for the Wenatchee sites. Table 6-7 summarizes them.

Table 6-7. Methow acclimation site water and space requirements

				REQUIRE	EMENTS						WATE	ER SI	JPPL	Υ			SPACE
	PROPOSED RELEASE NUMBER	CURRENT CAPACITY	WATER NEEDED (CFS)	REARING SPACE RQRT (CFT)	WATER SURFACE RQRT (ACRES)	Number of Ponds	POND LENGTH	POND WIDTH	LAND SURFACE RQRT (ACRES)	WATER SOURCE	APRIL FLOW	GRAVITY, GROUND	GRAVITY, SURFACE	INTAKE REQUIRED	PUMPED, GROUND	PUMPED SURFACE	EXISTING POND SIZE (CFT)
Ramsey	125,000	185,000	2.6	23,000	0.2					Ramsey			✓				
Poorman	137,500	100,000	2.8	25,000	0.2					Ground		√					
Lincoln	137,500		2.8	25,000	0.2					Twisp	Large		✓	√		√	36,000
Biddle	50,000	75,000	1.0	9,000	0.1					Wolf	2		✓	√			10,000
Hancock	100,000	200,000	2.1	19,000	0.1					Springs	9	√					
Goat Wall	50,000		1.0	9,000	0.1	1.0	94.9	31.6	0.1	Springs	Large	✓		√		√	

Environmental Conditions

Table 6-8 shows land use designations, ESA-listed fish species that might be near the sites, and other potential development risks for proposed Methow basin sites. These and other impacts will be evaluated in more detail during permit and decision processes, including the NEPA analysis.

Okanogan County zoning designations are defined as follows: RR, rural residential; VF, valley floor; MD, Methow review district. Riverine wetlands are associated with adjacent river systems and paulstrine are associated with small streams and marshes.

Check marks under the species listed in the Impacts column indicate that they are likely to be present near the intake or pond. The main impact to listed fish are barriers or intakes which impede migration around or through acclimation sites. Sites are designed to minimize these impacts, wherever possible.

The Development Risks section list some of the major issues that may prevent construction and/or operation of the sites and affect the facility development process. They include local opposition during construction permit application; low flow volumes; water rights issues; waste discharge addressed through the NPDES process; the availability (lease, purchase, or use agreement) of land; and access. A check mark in these columns signifies problematic issues identified during the preliminary analysis.

Table 6-8. Methow acclimation site environmental conditions

	LAND USE								ENV. IMPACTS				DEV. RISK			
	SONING	WETLAND DESIGNATION	FLOOD DESIGNATION	COMPREHENSIVE PLAN LAND USE	LAND USE	OWNERSHIP	MINIMAL FISH IMPACTS	BULL TROUT LIKELY	STEELHEAD LIKELY	SPRING CHINOOK LIKELY	LOCAL OPPOSITION	FLOW QUANTITIES	WATER RIGHTS	DISCHARGE IMPACTS	LAND OWNERSHIP	ACCESS
Ramsey	VF	Paulstrine	100 Yr	Ag	Rural residential	Private		✓	✓	√	√			✓	\	
Poorman	VF	Paulstrine	100 Yr	Ag	Rural residential	Private	\checkmark				√			\checkmark	✓	
Lincoln	VF	Riverine	100 Yr	None	Rural residential	Private		√	√	√		√	√	√		
Biddle	RR	None	None	Ag	Rural residential	Private	√							√		
Hancock	RR	Paulstrine	None	State	Pasture	Private		√	√	✓	√			√	✓	
Goat Wall	RR	Paulstrine	98 Yr	None	Rural residential	Private		√	✓	✓	✓	√	√	√	✓	

Additional Site Information

As in the Wenatchee, water effluent treatment systems that are separate from acclimation ponds are not planned. Predation deterrence techniques would be similar to those described for the Wenatchee. Site-specific details are described below.

Existing Sites

- *Ramsey*. This large pond on private land is fed by Ramsey Creek water. The site is located in the middle of the low-gradient section of the Chewuch.
- *Poorman*. Large ponds are fed by spring water. Although parts freeze over, the site is likely to be functional in winter. This site will introduce smolts into the lower Twisp.
- *Hancock*. Recent Yakama Nation restoration projects have replaced a road culvert, improved fencing, added woody debris, and improved flow conditions in the spring channel. It is now much more accessible to salmonids and has habitat that should be very attractive to spawning coho. Fry that migrate out of the spring can rear in the Methow mainstem. Net enclosures in the existing ponds would allow the site to be used by other species during coho acclimation.
- *Biddle*. This site has been used in the past by the MCCRP. It has an intake and off-line pond. The intake needs to be improved to minimize impacts to other salmonids in Wolf Creek.

New Facilities

- *Lincoln*. Ponds currently exist on the Lincoln property. The ponds are adjacent to the Twisp River. An unscreened culvert provides river water to the ponds. The culvert elevation allows water flow only at moderate to high discharge. A new intake that meets NMFS/WDFW screen criteria is required. Development of a pumped groundwater supply will provide water supply security and will allow winter operation. Existing vegetation will make placement of predator control fences difficult, but overhead nets can limit bird problems. This site puts coho into the upper portion of the low-gradient section of the Twisp.
- Goat Wall. A series of small ponds on private property are fed by springs at the base of Goat Wall. The ponds are valuable habitat for several species of plants, fish, and other wildlife and are not large enough to acclimate coho. As a result, it is proposed that a portion of the spring water be diverted into constructed ponds and that a new well be built to supplement the spring water. Adults produced from Goat Wall releases must migrate through a reach of the Methow River that frequently dewaters in late summer or early fall. However, releases from this site may encourage coho, when flow conditions allow, to return to the upper Methow above the dewatered area where quality coho habitat exists. Adult coho frequently migrate upstream during fall freshets which would provide passage in most years.

Chapter 7. Monitoring and Evaluation Plan



- 7.1 Project Performance Indicators
- 7.2 Species Interactions
- 7.3 Genetic Adaptability

Chapter 7. Monitoring and Evaluation Plan

The goal of the M&E program is to monitor and evaluate the results of reintroduction so that operations can be adaptively managed to optimize hatchery and natural production while minimizing any negative ecological impacts. Pursuing this goal, research data collection and analysis endeavors to: 1) demonstrate when the reintroduction program is meeting the established phased restoration goals; 2) determine whether a change in status of sensitive species is occurring and whether it is a result of coho reintroduction; and 3) provide science-based recommendations for management consideration.

The M&E plan is organized into three distinct categories: Project Performance Indicators, Species Interactions, and Genetic Adaptability. Project performance indicators are intended to evaluate how well reintroduced hatchery fish and the resulting naturally produced fish are surviving and adapting, whether certain reintroduction or hatchery practices can be modified to improve benefits achieved, and whether harvest levels threaten project success. Monitoring of project performance indicators will allow for adaptive management and evaluation of project progress toward successful reintroduction. Species interaction evaluations include monitoring the status of non-target taxa of concern (NTTOC) and investigating mechanisms of interaction (i.e., predation and competition). The species interactions evaluations described in this plan expand on issues examined during the feasibility phase and are integrated with other species monitoring ongoing or proposed in the two basins. Monitoring of genetic adaptability to local conditions is designed to determine whether the project is successfully creating a local broodstock distinct from lower Columbia River stocks in terms of genetic divergence and life history traits; and to determine the biological significance of the changes.

M&E results and plan objectives will be reviewed and revised every six years (two generations) to allow for modification of actions and adaptive management. NTTOC monitoring will continue until program termination, 5 generations (15 years) after starting the natural production phases.

7.1 Project Performance Indicators

7.1.1 Release-to McNary Smolt Survival

Objective: To estimate smolt-smolt survival (release to McNary Dam) for hatchery coho released in mid-Columbia tributaries.

Metric: Smolt-to-smolt survival index (Neeley 2004) Smolt - to - Smolt Survival Index to McNary

Estimated Number of tagged Fish passing McNary during stratum

Number of Fish tagged or released

Rationale: Mullan et al. (1992) and Chapman et al. (1994a; 1994b; 1995a; 1995b) recognize that a central limitation to building self-sustaining populations of anadromous fish in Wenatchee and Methow subbasins is the high smolt and adult mortalities incurred at the numerous hydropower facilities on the mainstem Columbia River. Mortalities related to hydropower facilities can severely reduce the escapement numbers. Salmon abundance is also heavily influenced by ocean conditions. Freshwater conditions reflect variability within a broader spectrum of population abundance that is largely controlled by ocean conditions (Mullan et al. 1992; Nickelson 1986). Therefore we feel it is important to monitor survival of hatchery juveniles in freshwater to help partition smolt-to-adult survival of hatchery reared Program fish into the components of freshwater and marine mortality.

Smolt-smolt survival rates will be used to compare the "quality of smolt" produced by different rearing strategies, acclimation sites, acclimation duration, and time of release. Smolt-smolt survival indices will be used to evaluate rearing strategies and rearing facilities, to include current and proposed facilities, evaluations of growth rates, acclimation length, and smolt size. Knowledge of how rearing and environmental conditions affect smolt survival allows researchers to adaptively manage the reintroduction effort to maximize survival. Smolt-smolt survival indices will be used to parse out that portion of mortality that is occurring during emigration.

Restoration Phases: BDP1, BDP2, NPIP. Smolt-smolt survival rates will be measured during NPSP if smolt-to-adult rates are not meeting program goals and further investigation into survival is warranted

Methods: Groups of juvenile coho, ranging in size from 3,500 to 8,000, depending upon release location, will be PIT-tagged 3-6 months prior to release. PIT-tagged coho will be released from a minimum of one upper Wenatchee River acclimation site, LNFH, and Methow River site. PIT groups will also be released from ponds which have not previously been used for coho acclimation, and sites where smolt-to-adult survival rates are below expectations. All PIT tagging will follow protocols described in the PIT TAG Marking Procedures Manual (CBFWA 1999). When possible, volitional releases will be monitored for PIT tags. Survival estimates will be calculated based on subsequent PIT detections at McNary, John Day, and Bonneville Dams following methods described in Neeley 2004.

7.1.2 In-Pond Survival

Objective: To estimate in-pond (transport-to-release) survival of hatchery coho.

Metric: In-pond survival estimate based on PIT tag releases (Neeley 2004) or predator and mortality observations (Kamphaus and Murdoch 2005).

Rationale: In-pond survival estimates will increase the accuracy of smolt-to-adult and smolt-smolt survival estimates. In-pond survival estimates will be used to evaluate the success of acclimation ponds and predator control strategies, allowing researchers to maximize survival through adaptive management.

Restoration Phases: All phases.

Method: Groups of approximately 3,500 to 8,000 juvenile coho will be PIT tagged 3-6 months prior to release (see **Section 7.1.1 Release-to McNary Smolt Survival**). In-pond survival estimates based on PIT tags are possible only in ponds with monitored releases. In-pond survival based on PIT tags will be calculated following methods described in Neeley 2004. In-pond survival rates from acclimation sites that do not have PIT tag detection capability will be estimated based on moribund fish, numbers of predators observed, and predator consumption rates (Kamphaus and Murdoch 2005).

7.1.3 Pre-Release Fish Condition

Objective: To provide a comparative measure of fish condition and stage of smoltification prior to release.

Metric: Stage of smoltification will be measured as the proportion of fish which, upon visual examination, appear to be smolts, transitional (in the process of becoming a smolt), or parr. Fish condition will be assessed based on size and the amount of growth in the pond, and on a pre-release examination of external features such as fins and eyes; of internal organs including kidney and liver; and of mesenteric fat levels and blood components (% volume of red and white blood cells, plasma protein levels).

Rationale: Pre-release fish condition examinations are intended to assess the normality or overall health of the population. These examinations will allow researchers to compare fish condition between ponds and between years as a measure that may affect survival.

Restoration Phases: All phases.

Methods: A random sample of 100 fish from each acclimation pond will be used to measure stage of smoltification and growth weekly until release. The pre-release fish condition assessment will be done once within 72 hours of release. Detailed methods describing how stage of smoltification is determined and how pre-release fish condition examinations are conducted can be found in Kamphaus and Murdoch 2005.

7.1.4 Volitional Release Run-Timing and Tributary Residency

Objective: To describe volitional release patterns, peak migration from acclimation ponds, duration of time spent in tributaries post-release, and run timing to McNary Dam.

Metric: Run timing, in hours, calculated from PIT tag detections during monitored releases to recapture in tributary traps (i.e., smolt traps) and Columbia River PIT detection facilities.

Rationale: Knowing tributary residence time will enable researchers to better understand the potential for interaction between hatchery coho and listed and sensitive species (see **Section 7.2 Species Interactions**). We will examine the relationship between volitional exit date and tributary residence time, allowing for programmatic changes to minimize potential negative interactions. The correlation between volitional exit date and smolt-smolt survival may also enable researchers to maximize survival of hatchery fish by releasing hatchery coho at an optimal time.

Run timing is a life history attribute which may change with the development of a local broodstock (see **Section 7.3.1 Morphometrics and Life History Traits**). As natural production increases during the NPIP and NPSP, run timing will be measured for both naturally produced and hatchery coho based on the distribution of migrating naturally produced coho captured in tributary smolt traps.

Method: Using the same groups of 3,500 to 8,000 PIT-tagged juvenile coho as described in **Section 7.1.1 Release-to McNary Smolt Survival**, tributary residence time will be calculated from ponds with PIT tag detection capabilities (e.g., Butcher Creek Pond, Mahar Pond). Dates and times of reported recaptures in tributary traps and Columbia River PIT tag interrogation facilities will be used to calculate residence time and run timing.

7.1.5 Spawning Escapement and Distribution

Objective: To estimate in-basin spawning escapement and distribution for both hatchery origin returns (HORs) and natural-origin returns (NORs).

Metric: Annual redd counts, escapement estimates and spawning ground composition.

Purpose: Redd counts will provide an estimate of spawning escapement and distribution of reintroduced coho salmon. The counts, along with spawning composition (pNOS and pHOS) and distribution, will allow researchers and managers to determine the efficacy of the reintroduction effort, collect empirical productivity data and determine whether spawning ground composition goals for each phase are being met.

Hypotheses:

o Implementation Phase − H_o : pHOS ≤ 90% o Support (I) Phase − H_o : pHOS ≤ 75% o Support (F) Phase − H_o : pHOS ≤ 60%

Restoration Phases: All phases.

Method: Spawning escapement and distribution will be evaluated in terms of redd counts and an estimate of fish per redd (based on sex ratio observed at in-basin trapping facilities). Spawning ground surveys will be conducted in all tributaries where juvenile coho have been released and other tributaries that have coho spawning attributes such as low gradient, adequate winter flow and small gravel, about 25mm (Quinn 2005). Radio-telemetry techniques may be used, particularly during the natural production phases, to identify previously unknown coho spawning locations, ensure that all spawning reaches are surveyed, and to identify spawning locations of straying coho. A description of protocols for both spawning ground surveys and radio telemetry can be found in Murdoch et al. 2005.

7.1.6 Natural Smolt Production

Objective: To provide a population estimate of naturally produced coho smolts emigrating from the Wenatchee and Methow rivers.

Metric: Population estimates of both spring and fall emigrating coho with 95% confidence intervals.

Rationale: Natural smolt production estimates are a measure of productivity. Smolt production estimates will be used to evaluate program progress and success in terms of egg-to-emigrant survival rates and smolt-to-adult survival rates. Natural smolt population estimates during all phases are essential to accurately measure key project performance indicators, such as smolt-to-adult survival rates.

While the broodstock development phases primarily focus on the development of a local broodstock, rather than on natural production, some natural production will occur during these early phases, likely in a geographically limited area. Fish trapping facilities at Dryden Dam are not 100% efficient, presumably resulting in some natural production on a limited geographical scale. It is important to collect data regarding natural production during the broodstock development phases because early measures of productivity (i.e., smolts per spawner, egg-to-emigrant survival, etc.) on a basin-wide scale will provide a rough baseline measure of the success of natural spawners prior to the natural production phases.

Restoration Phases: All Phases.

Methods: Operation of rotary smolt traps, protocols for fish handling, and data analysis will proceed as described in Murdoch et al. (2005) and Hillman (2004). Traps will be operated annually between March 1 and November 30.

Broodstock Development Phases: During broodstock development phases we will coordinate with ongoing monitoring activities to reduce duplication of activities. Currently in the Wenatchee basin, WDFW operates a rotary smolt trap near the town of Monitor. Through a cooperative effort, this trap will be used to provide population estimates for naturally produced coho as it was during the feasibility phase. The YN-operated smolt trap in Nason Creek will provide a tributary-specific population estimate. Similar coordination with WDFW in the Methow basin should provide a basin-wide coho population estimate for the Methow.

Natural Production Phases: All monitoring efforts, including population estimates during the natural production phases, will be coordinated with other co-managers and recovery processes to avoid unnecessary duplication of efforts and cumulative handling effects. In tributaries currently without means of estimating smolt production, the YN proposes to operate either a rotary smolt trap or other sampling equipment during the spring and fall emigration periods to estimate the number of natural coho emigrants.

7.1.7 Egg-to-Emigrant Survival Rates

Objective: To estimate egg-to-emigrant survival rates for naturally produced coho salmon in mid-Columbia tributaries.

Metric: Egg-to-Emigrant Survival (S) will be expressed as the ratio of the estimated number of emigrant coho (C_e) and the estimated number of eggs deposited (E_d).

$$S = C_e/E_d$$

Rationale: The egg-to-emigrant survival rate will provide data to determine which tributaries are most productive for coho production. The relationship between egg-to-emigrant survival and seeding level will assist researchers in developing tributary-specific empirically derived estimates of carrying capacity.

We assume that the freshwater productivity (expressed as an egg-to-emigrant survival rate) will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

 $_{\circ}$ H_o: Egg-to-Emigrant Survival Broodstock Development Phases \geq Egg-to-Emigrant Survival Implementation Phase \geq Egg-to-Emigrant Survival Support Phase

Restoration Phases: Egg-to-emigrant survival rates will be calculated on a basin-wide scale during the broodstock development phases (i.e., total number of redds vs. total number of emigrants). During the natural production phases we will calculate egg-to-emigrant independently in each tributary of reintroduction.

Methods: The number of emigrant coho will be estimated from tributary trap data as described in **Section 7.1.6 Natural Smolt Production**. The number of eggs deposited will be calculated from the number of redds observed (see **Section 7.1.5 Spawning Escapement and Distribution**). Both basin-wide and tributary specific estimates will be calculated.

7.1.8 Smolt-to-Adult Survival (SAR)

Objective: To measure smolt-to-adult survival for hatchery and natural origin coho.

Metric: Smolt-to-adult survival will be calculated as follows:

 $S_{smolt-adult} = Adults$ and Jacks $b_{roodvear X} / Smolts$ $b_{roodvear X}$

Where S smolt-adult is the estimated smolt-to-adult survival rates; Adults and Jacks broodyear X is the number of adult coho to return from broodyear X; Smolts broodyear X is the population of emigrating smolts.

Rationale: For hatchery fish, smolt-to-adult survival will be used to test the premise that SARs will increase with the development of a local broodstock. SARs will also be used to compare the "quality of smolt" produced by different rearing strategies, acclimation sites, acclimation duration, and time of release. Knowledge of how smolt-to-adult survival indices correlated with rearing and environmental conditions will allow researchers to adaptively manage the reintroduction effort to maximize survival. The SAR will be used to evaluate rearing strategies and rearing facilities to maximize survival. Evaluations will include facility comparisons (currently ongoing), comparisons of growth rates, smolt size, and acclimation length (currently ongoing).

We assume that the survival of Wenatchee and Methow river coho salmon will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

H_o: Smolt-to-Adult Survival Broodstock Development Phases ≥ Smolt-to-Adult Survival Implementation Phase ≥ Smolt-to-Adult Survival Support Phase

Methods: SARs will be calculated for both naturally and hatchery produced coho. We plan to mark 100% of the hatchery fish released under this program with CWTs. CWTs will be used to calculate SARs from each release group and location, and will be used to distinguish hatchery from natural fish (no CWT). Pre-release CWT retentions will be used to estimate the number of fish with CWTs released. To verify origin, scale samples will be taken from all adult coho that do not have a CWT. During the broodstock development phases, SARs for hatchery and naturally produced coho will be calculated based upon the number of smolts released (hatchery), smolt emigration estimates from WDFW's Wenatchee River smolt trap (RM 7.1), and CWTs recovered from hatchery and naturally produced coho collected at Dryden Dam for broodstock. During the natural production phases, tributary-specific SARs may be based on carcass recovery and tributary population estimates, in addition to the basin-wide metric described above.

7.1.9 Adult-to-Adult Productivity

Metric: Adult productivity will be measured in the Wenatchee and Methow broodstock collection facilities and on the spawning grounds (through carcass recovery) for naturally spawning fish. Adult-to-adult survival will be calculated as follows:

$$P_{adult} = S2/S1$$

Where P_{adult} is the estimated adult-to-adult survival; S_2 is the number of returning adults (including jacks); and S_1 is the number of adults from the parent brood year producing the S_2 returning adults. A P_{adult} value that averages greater than 1.0 over several generations indicates that the population is increasing.

Rationale: The adult-to-adult survival rate measures the productivity of reintroduced coho, providing an overall indicator of project success. During the NPIP, P_{adult} may indicate which tributaries are the most productive.

We assume that the productivity of Wenatchee and Methow river coho salmon will increase as domestication selection is reduced, local adaptation is emphasized and habitat improvement projects are implemented.

Hypothesis:

 $_{\circ}$ H_{o} : $P_{Broodstock\ Development\ Phases} \geq P_{Implementation\ Phase} \geq P_{Support\ Phase}$

Restoration Phases: Natural Production Phases

Methods: Coho collected for broodstock and naturally spawning coho carcasses will be interrogated for the presence of CWTs. Scales will be taken from coho that are not marked with a CWT to confirm origin. These data will be used in calculations described under **Metric.**

7.1.10 Harvest Rates

Objective: Estimate out-of-basin harvest rates of program fish in order to determine if harvest rates are likely to limit project success.

Rationale: Harvest may have been a significant factor in the disappearance or reduced number of coho in both the distant and recent past. Currently the majority of coho in the Columbia River are produced and released below Bonneville Dam. The historical intent of this production was to supply coho for the 80-90% exploitation rate by ocean and lower Columbia River fishers. However, since the period 1988-1993, harvest rates of coho (commercial ocean troll and recreational) have decreased by approximately 25% (PFMC 1999). Harvest reductions were the result of mixed stock fishery issues related to the Endangered Species Act. Coho released under this project are subject to the following fisheries: ocean commercial troll fisheries, ocean recreation fisheries, Buoy 10 recreational fisheries, lower Columbia River commercial fisheries, lower Columbia River recreational fisheries, Zone 6 (Bonneville to McNary dams) Treaty Indian commercial fisheries, and above-Bonneville Dam recreational fisheries. All recreational fisheries and the ocean commercial troll fisheries are selective for adipose-fin-clipped fish. Harvest mortality for project fish in these fisheries will primarily be limited to incidental mortality, so we have no ability to recover CWTs from these fisheries. The Columbia River commercial coho fisheries (Buoy 10 to Bonneville Dam) do intercept both adipose-clipped and non-clipped fish. All coho captured in this fishery are examined for the presence of a CWT, with an approximate sampling rate of 20%. Presently, harvest monitoring of Treaty Indian fisheries does not include recovery of CWT. Although the total harvest rate on adipose-clipped fish could be as high as 50-60%, the total harvest rate on non-adipose-fin-clipped fish is substantially lower (20-25%) due to the selective fisheries that are likely to remain in place for many years as a result of ESA constraints.

Restoration Phases: All phases.

Methods: We will coordinate with agencies responsible for harvest management (WDFW, ODFW, USFWS, CRITFC, etc.) to estimate the harvest rates of target stocks by querying existing databases that may contain harvest or stray information for program fish.

7.2 Species Interactions

During the feasibility phase, the YN completed several studies to evaluate predation and competition by hatchery coho with listed and sensitive species (Dunnigan 1999; Murdoch and Dunnigan 2002; Murdoch and LaRue 2002; Murdoch et al. 2004; Murdoch et al. 2005). Results of these studies indicate low predation rates and species-specific habitat segregation (see **Chapter 3**). Stream dwelling salmonids that have evolved in sympatry have developed mechanisms to promote coexistence and to partition the available habitat. Studies with coho salmon and steelhead trout (Hartman 1965; Johnson 1967; Fraser 1969; Allee 1974), chinook salmon and steelhead trout (Everest and Chapman 1972), chinook salmon and coho salmon (Lister and Genoe 1970; Stein et al. 1972; Murphy et al. 1989), coho salmon and cutthroat trout (Bjornn 1971; Bustard and Narver 1975; Sabo and Pauley 1997) and coho salmon and dolly varden (Dolloff and Reeves 1990) all support this statement.

Mechanisms to measure negative interactions between hatchery fish and other species have been studied by others (Larkin 1956; Fraser 1969; Stein et al. 1972; Glova 1986; Marnell 1986;

Cannamela 1993; Riley et al. 2004), but impacts to non-target species in terms of abundance, distribution and size have not been conclusively measured (Fresh 1997, Pearsons et al. 2004) on a basin-wide scale. Interactions between reintroduced coho and listed and sensitive species will be evaluated through an integrated NTTOC monitoring program. A basin-wide NTTOC monitoring program has been implemented in the Yakima River (Busak et al. 1997, Hubble et al. 2004; Pearsons et al. 2004).

NTTOC status monitoring (**Section 7.2.1**) answers the question "Are there adverse changes in the status of NTTOC in tributaries where coho have been introduced?". NTTOC status monitoring does not answer questions of whether coho caused the changes in NTTOC status or the mechanism of change (i.e., predation, competition, etc.). The studies outlined in **Section 7.2.2** address those causal questions.

Species interaction monitoring will continue for a minimum of six years (two coho generations) during the NPSP, but may continue longer pending results.

7.2.1 Status of Non-Target Taxa of Concern (NTTOC)

During the feasibility phase of the Mid-Columbia Coho Reintroduction Program, the HGMP (YN et al. 2002) and the mid-Columbia Coho Technical Workgroup (TWG) identified a number of critical uncertainties associated with coho reintroduction and species interactions. Studies implemented during the feasibility phase (see Chapter 3) answer many of those uncertainties, including the rates of predation by hatchery coho on spring chinook fry and on sockeye fry. One main question remains unanswered, that of the predation rate of naturally produced coho on spring chinook fry. As stated in Chapter 3, numbers of naturally producing coho were not sufficient to undertake a meaningful study (Murdoch et al. 2005). The study described in **Section 7.2.2.2** proposes to address this remaining question.

With most of the critical uncertainties answered, the proposed NTTOC monitoring plan is designed to integrate the coho reintroduction effort with other ongoing programs to monitor the status of listed and sensitive species. The non-target taxa monitoring program will focus on the status and freshwater residence of spring chinook and steelhead, but data on all other species encountered, such as bull trout, cutthroat trout, lamprey and sockeye, will also be collected.

We define status as the interaction of abundance, distribution, and size. A change in status is the deviation from baseline conditions. A change in status does not indicate causation, but if coho reintroduction has a negative impact on listed and sensitive species, decline in status would occur. If a decline in status is detected, further investigations into the mechanism of interaction and source of decline are warranted (see Section 7.2.2). This NTTOC monitoring plan is consistent with current and proposed plans to monitor species interactions in the Wenatchee and Yakima basins (Busak et al. 1997; Hubble et al. 2004; Murdoch and Peven 2005).

To provide baseline data for evaluating effects of coho reintroduction, monitoring will begin during the broodstock development phases when the hatchery coho are released on a geographically limited scale and numbers of naturally spawning coho in tributaries containing spring chinook and steelhead will be minimal. Baseline monitoring will be done in all tributaries proposed for future coho releases during the natural production phases. Monitoring of changes in tributaries with no previous coho release will occur during the Implementation Phase. The study design will include both a temporal and spatial control. Baseline data collected prior to

coho reintroduction will function as a temporal control from which to compare any change in NTTOC status.

7.2.1.1 Reference Stream Comparisons

For a spatial control, we propose to use the Entiat River as a reference population of chinook and steelhead from which any observed changes in abundance (as measured through egg-to-emigrant survival rates), distribution, or size can be gauged.

The Entiat River has been proposed by the resource managers (NOAA, WDFW, YN, USFWS, Colville Tribe), Chelan PUD and Douglas PUD as a reference stream for both spring chinook and steelhead, to measure the success of the PUDs' HCP hatchery programs (Murdoch and Peven 2005). As such, analysis to determine the ultimate suitability of the Entiat River as a reference stream for spring chinook and steelhead, along with the data required to compare changes in size, abundance and distribution would be collected by the HCP monitoring activities funded by CCPUD and DCPUD hatchery compensation programs (Murdoch and Peven 2005). Reference stream suitability criteria have been adapted from the Chelan and Douglas HCP hatchery compensation program M&E plan (Murdoch and Peven 2005) and include the following:

- o No recent (within the last 5-10 years) hatchery releases directed at target species
- o Similar information of hatchery contribution on the spawning grounds
- Similar fluvial-geomorphologic characteristics
- Similar out-of-subbasin effects
- Similar historic records of productivity
- Appropriate scale for comparison
- o Similar in-basin biological components, based upon analysis of empirical information.

Currently the USFWS generates population estimates of juvenile salmonids through rotary trap operation, uses underwater observation techniques to estimate juvenile rearing distribution, and conducts spawning ground surveys for spring chinook, summer chinook, and steelhead in the basin. The use of the Entiat River as a potential reference stream for steelhead and spring chinook precludes the release of these species in the Entiat Basin, making the Entiat River similarly a reference stream to gauge potential NTTOC interactions as a result of coho reintroduction in the Wenatchee and Methow.

The NTTOC monitoring plan builds on, and will be coordinated with, ongoing monitoring efforts in the Wenatchee, Entiat and Methow basins, thus avoiding duplication of efforts and minimizing cumulative handling effects and costs. The NTTOC monitoring program is designed to provide data to measure the effects of both Type I and Type II interactions. Type I interactions are those that occur between hatchery fish and wild fish, while Type II interaction may occur between NTTOC and the naturally produced offspring of hatchery fish (Pearsons and Hopley 1999).

7.2.1.2 Size Structure

Objective: To monitor size (growth and K-factor) of NTTOC and juvenile coho in all tributaries proposed for coho reintroduction.

Rationale: The size, condition, and growth of NTTOC and juvenile coho, combined with abundance and distribution data, will be used to evaluate the effect, if any, of coho reintroduction. Baseline monitoring during the broodstock development phases will establish trends in size, abundance and distribution of NTTOC prior to the natural production phases. During the natural production phases, the rotational release schedule of the NPIP will provide a means to compare size, abundance, and distribution of NTOCC in coho release tributaries with those same factors in tributaries without coho releases. Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control in which to evaluate any changes in NTTOC size.

Hypotheses:

- o H_o: NTTOC Size before reintroduction < NTTOC Size after reintroduction
- o H_o: NTTOC Size treatment stream < NTTOC Size reference stream

Restoration Phases: Baseline monitoring during broodstock development phases; change monitoring during the natural production phases.

Methods: The importance of monitoring size and growth of NTTOC in both the treatment and references streams prior to reintroduction of coho is emphasized. Because seeding levels and intra-specific competition can influence the size structure of each population, a careful analysis of the relationship between seeding levels, survival, and growth should be established in each tributary (treatment and reference) in order to gauge effect change.

From tributaries with smolt trapping programs in the Wenatchee basin (Nason Creek, Chiwawa River, Peshastin Creek), the Methow River (Twisp River, Mainstem Methow), and the Entiat River, we will determine whether the catch at the trap can be used to measure size and growth. Currently the Nason Creek smolt trap is operated by the YN as a cost-sharing effort between two BPA projects (Project # 1996-040-00 and #2003-017-00). The Chiwawa River trap is operated by WDFW and the Peshastin Creek trap is operated by the USFWS. A smolt trap in the White River is currently proposed by WDFW. In the Methow River, the Twisp and Methow rivers traps are both operated by WDFW. The USFWS operates a rotary smolt trap in the Entiat River (reference populations).

Up to four index sites of 200 meters in length will be established in each tributary with current or future proposed coho releases and in the Entiat River. Index sites will be selected for their accessibility, proximity to spawning areas, and habitat availability. Within these index sites, we will collect a sample of up to 50 chinook and 50 steelhead with a backpack electro-fisher. Sample sizes may be adjusted following power analysis of actual data. We will sample three times per year (March, July/August, November) and compare the size and condition of the electro-fishing sample to the catch at the trap for the same time period. We will test the null hypothesis that juvenile chinook and steelhead captured in the smolt trap are the same size as juvenile chinook and steelhead captured with a backpack electro-fisher. If we find no statistical difference in size and condition of fish collected with a backpack electro-fisher and fish collected with the smolt trap, then data collected from the smolt trap will be used to monitor size and growth of NTTOC. If the size of the fish from the two

sample methods is not the same, then size and condition sampling will proceed using the same methods as tributaries without smolt traps (see next paragraph). Size and growth will also be calculated for juvenile coho.

From tributaries without a current smolt trapping program, the Little Wenatchee River, and the Chewuch River, we will collect a sample of juvenile chinook and steelhead from up to four index sites (as described in the above paragraph), three times per year (March, July/August, November). The sample sizes will be determined by the abundance of NTTOC and juvenile coho. Sampling will be conducted using a backpack electro-fisher. This device temporarily immobilizes juvenile salmonids with varying levels of direct current (DC), dependant on water conductivity. Our ability to detect a difference in growth will be determined with power analysis and sample sizes, or methods will be adjusted if statistical power is too low. Collected fish will be anesthetized in a solution of MS-222 measured to the nearest millimeter and weighted to the nearest .01 gram. Sampled fish will be allowed to fully recover before release.

In order to avoid duplication of efforts, this portion of the monitoring plan will be closely coordinated and integrated with ongoing evaluations in the Wenatchee and Methow basins, including but not limited to Integrated Basin Wide Monitoring (BPA project #2003-017-000), and M&E activities associated with supplementation projects funded by the mid-Columbia PUDs.

7.2.1.3 Abundance and Survival

Objective: To measure the abundance and corresponding survival rates for NTTOC in target tributaries.

Rationale: See **Section 7.2.1.2**. Abundance of NTTOC, in-terms of population size and survival rates (egg-to-emigrant survival), will be used to evaluate the effect, if any, of coho reintroduction. Baseline monitoring during the broodstock development phases will establish trends in abundance and survival prior to the natural production phases. Abundance and survival monitoring for spring chinook and steelhead in Nason Creek, Chiwawa River, White River, Wenatchee River, Twisp River, Methow River, and Entiat River are currently ongoing or proposed under other programs. We propose to continue this monitoring as baseline and effect monitoring throughout the broodstock development and natural production phases.

Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control. Inclusion of the Entiat River in the monitoring plan will allow for a spatial control or reference stream.

Hypotheses:

- H_o: NTTOC Egg-to-Emigrant Survival before reintroduction < Egg-to-Emigrant Survival after reintroduction
- H_o: NTTOC Egg-to-Emigrant Survival treatment stream < NTTOC Egg-to-Emigrant Survival reference stream

Methods: It is important to monitor NTTOC abundance in terms of egg-to-emigrant survival in both the treatment and reference streams before reintroduction of coho. Currently such monitoring is ongoing in Nason Creek, Chiwawa River, White River, Peshastin Creek, Twisp River, Methow River, and Entiat River. Because seeding levels and intra-specific

competition directly influence the egg-to-emigrant survival rate (stock-recruitment curve) of each population, a careful analysis of the relationship between seeding levels, survival, and growth should be established in each tributary (treatment and reference) in order to gauge effect change.

Current on-going smolt trapping programs in Nason Creek, Chiwawa River, White River, Peshastin Creek, Wenatchee River, Twisp River and Methow River will form the basis for the NTTOC abundance and survival estimates. Similar traps on the Chewuch River and Little Wenatchee are proposed for coho natural production monitoring during the natural production phases and will also be used to collect abundance and survival data for the NTTOC monitoring program. In addition to ongoing and proposed smolt trapping programs described above, up to four index sites of 200 meters in length will be established in each tributary with current or future proposed coho releases; the same index sites will be used for growth monitoring. Within these index sites, we will estimate rearing densities three times annually (March, July/August, November). Rearing densities will be estimated through underwater observation. We will evaluate the baseline relationship between egg-seeding level, rearing densities, and egg-to-emigrant survival for NTTOC before and after coho reintroduction.

Restoration Phases: Baseline monitoring will proceed as described above during the broodstock development phases in all tributaries proposed for future coho releases. Monitoring of changes will be done during the natural production phases. Any change in NTTOC status during this monitoring will be closely evaluated in subsequent studies such as those described Section 7.2.1.2, to determine if the coho reintroduction efforts are causing the observed change or if other factors may be involved.

Methods: Smolt trap operation for emigrant population analysis will proceed as described in Hillman (2004) and Prevatte and Murdoch (2004). We will follow protocols for underwater observation as described in Thurow (1994) and for electro-fishing in Temple and Pearsons (2004). The same index sites will be monitored annually. Any correlation between egg-seeding level, indexed rearing density, egg-to-emigrant survival, and emigrant population estimates will be analyzed using multiple regression techniques (Zar 1999).

In order to avoid duplication of efforts, NTT abundance and survival monitoring will be closely coordinated with ongoing monitoring and evaluation programs in the Wenatchee and Methow basins, including but not limited to BPA project #2003-017-000 Integrated Status and Monitoring Program, and M&E activities funded by the mid-Columbia PUDs.

7.2.1.4 Distribution of NTTOC

Objective: To evaluate the status of NTTOC in terms of their distribution throughout each basin.

Rationale: Data on the distribution of NTTOC and juvenile coho, in combination with abundance and size data, will enable researchers to evaluate changes in NTTOC status during the coho reintroduction process.

Baseline monitoring in all tributaries with proposed coho releases will provide a temporal control. Inclusion of the Entiat River in the monitoring plan will allow for a spatial control or reference stream.

Hypotheses:

- o H_o: NTTOC Distribution before reintroduction < NTTOC Distribution after reintroduction
- H_o: NTTOC Distribution treatment stream < NTTOC Distribution reference stream

Restoration Phases: Same as for size and abundance monitoring.

Methods: It is important to monitor NTTOC spawning and rearing distribution in both the treatment and reference streams before reintroduction of coho. Currently NTTOC monitoring is ongoing in Nason Creek, Chiwawa River, White River, Peshastin Creek, Twisp River, Methow River, and Entiat River). A careful analysis of the relationship between seeding levels, survival, and distribution should be established in each tributary (treatment and reference) in order to gauge effect change.

Distribution will be evaluated in terms of adult spawning distribution (adult spawning distribution data are collected by WDFW and CCPUD), and juvenile rearing distribution, through the annual monitoring of up to four index sites in each tributary and results of the Integrated Status & Effectiveness Monitoring Program (BPA Project No. 2003-017-00). The same index sites identified for size structure and abundance and survival monitoring will be used to evaluate distribution. The index sites will be sampled three times annually through snorkel or electro-fishing techniques described in the sections on size and abundance monitoring.

7.2.2 Mechanism of Interaction

7.2.2.1 Competition

Objective: To continue to evaluate competition for space and food between naturally produced coho and NTTOC.

Rationale: If the status of NTTOC is determined to have declined, continued investigations into competition between reintroduced coho and NTTOC will help determine the cause of the decline and, if necessary, programmatic changes that can be made to minimize negative interactions between coho (hatchery and/or natural) and NTTOC.

Hypotheses: Possible hypotheses to investigate include the following:

- o H_o: NTTOC microhabitat with coho = NTTOC microhabitat use without coho
- o H_o: NTTOC growth with coho = NTTOC growth without coho
- o H₀: Coho microhabitat use = NTTOC microhabitat use

Methods: Competitive interactions between species are often investigated using two general techniques: controlled field studies or laboratory investigations (using aquaria or enclosures). Field studies can lack statistical power, but are seldom criticized for lacking relevance to actual conditions. Through studies in aquaria or enclosures, statistical power is more easily achieved through replication, but the natural conditions which closely parallel the stream ecosystem are difficult to duplicate.

To investigate competition, a combination of approaches may be used, including field studies similar to those conducted during the feasibility phase (Murdoch et al. 2004, Murdoch et al. 2005) or direct measures of competition such as growth and condition of NTTOC in small-scale enclosures with varying abundance of competitors under differing habitat and

environmental conditions. Together competition studies may help ascertain conditions under which competition may have a negative effect on NTTOC.

7.2.2.2 Predation by Naturally Reared Coho on Spring Chinook Fry

Objective: To quantify predation rates by naturally produced coho on spring chinook fry.

Rationale: The extent to which naturally produced coho may prey upon NTTOC in the Wenatchee and Methow rivers is largely unknown. Preliminary investigations during the feasibility phase documented that some naturally produced coho smolts will consume fry sized fish. Due to the low numbers and abundance of naturally produced coho in areas of ESA-listed spring chinook production during the feasibility phase, it was not possible to accurately measure incidence of predation (Murdoch et al. 2005).

Restoration Phases: Predation evaluations will occur during the NPIP. The tributary(s) chosen for the predation evaluation(s) will be based on the natural production rates and resources for fish capture.

Methods: A study to determine the incidence of predation and an estimate of the total number of spring chinook fry consumed will follow methods described in Murdoch et al. (2005). The study may be replicated in more than one tributary as deemed necessary to adequately assess the extent that predation may occur.

7.3 Genetic Adaptability

Few opportunities in the Columbia Basin exist to investigate the local adaptation process required for a species reintroduction project to be completely successful. This coho reintroduction plan presents such an opportunity to understand the natural selection intensities on naturalized coho. Success of this coho reintroduction program relies on the use of hatchery fish to develop naturalized spawning populations. Until recently the project has relied entirely upon the transfer of lower Columbia River hatchery coho to produce adult coho returns. If a viable self-sustaining population of coho is to be re-established in the Wenatchee and Methow basins, parent stocks must possess sufficient genetic variability to allow the newly-founded population to respond to differing selective pressures between environments of the lower Columbia River and the mid-Columbia region. There are likely to be some changes in the life history characteristics of the introduced broodstock due to multiple factors including longer migration distance, differing environmental conditions of inland rivers, and historical artificial selection on donor stocks. Several of the life history characteristics that might be expected to differ could be endurance, run timing, sexual maturation timing, fecundity, egg size, length at age, juvenile migration timing, sex ratio, and allele frequencies of non-neutral loci. Therefore a long-term monitoring effort will be continued to track changes over several generations.

Implementation of the proposed study plan would be a valuable contribution to the science of salmon recovery by quantitatively addressing the following questions:

- 1) Is divergence at neutral and adaptive SNP (Single Nucleotide Polymorphism)¹¹ loci a useful measure of reproductive isolation and adaptation?
- 2) Is phenotypic divergence (if observed) a useful proxy for local adaptation, or are observed differences simply the result of phenotypic plasticity?
- 3) What is the biological significance to perceived local adaptation/naturalization?
- 4) What is the mechanism leading to local adaptation, and how quickly can stocks react to alternative natural selection regimes?

7.3.1 Morphometrics and Life History Traits

Metric: We will measure traits such as fecundity, body morphometry, run timing, maturation timing, length-at-age and spawn timing.

Rationale: Because conditions in mid-Columbia tributaries are likely to be different from coastal streams and the lower Columbia River where the broodstock used for reintroduction originated, life history characteristics of reintroduced coho are likely to change. For one, the migration distance is much greater between the ocean and the mid-Columbia than, for example, between the ocean and Cascade Fish Hatchery. Optimal maturation rates and spawn timing are likely to be different between these two areas. In order to determine if the stock used has adequate genetic variance and phenotypic plasticity to adapt to local conditions, the life history characteristics of the coho broodstock should be monitored over the length of the program.

Monitoring life history traits and morphometics of mid-Columbia coho will contribute to answering broader questions about the rate of genetic drift when a broodstock is established in a subbasin.

Methods: Through sampling efforts in the Wenatchee and Methow basins, we will collect morphometric and life history data from the reintroduced population. From adult coho captured for broodstock (HORs and NORs) we will collect data from phenotypic traits such as fecundity, body morphometry and maturation timing. Similar data will be collected from HORs and NORs recovered on the spawning grounds. Trend monitoring will be used to ascertain changes in life history or morphometry for each generation.

7.3.2 Genetic Monitoring

Objective: To determine whether the project is successfully creating a local broodstock distinct from lower Columbia River coho salmon stocks; to measure the rate of divergence at neutral markers, and to determine the biological significance of local adaptation.

Metric: We will measure the rate and direction of divergence in neutral and adaptive allele frequencies of coho stocks that are used for reintroduction in mid-Columbia rivers.

SNP – Single nucleotide polymorphism; an alteration of one base in the genome of an organism (e.g., $A \Leftrightarrow G$ or $C \Leftrightarrow T$).

Rationale: A sound understanding of the genetic structure of the species is a prerequisite for the assessment of the genetic impacts of human activities such as introductions, transfers, or stock enhancement on natural populations. A measure to assess the impact of human activities on natural populations is the degree to which the population structure responds to applied management action. This can be done by measuring the frequencies of alleles at specific loci through time in a population (Allendorf and Phelps 1981; Utter 1991; Allendorf 1995). Such a database permits the determination of temporal and geographic (degree of isolation) variance components.

Within the body of peer reviewed literature, scientific views remain mixed regarding the scale and biological significance of perceived local adaptations (Taylor 1991b; Purdom 1994). Utilizing both neutral and adaptive SNP loci provides the opportunity to evaluate the biological significance of genetic differentiation among stocks. The coho reintroduction effort in the mid-Columbia provides an ideal framework for studying rates of genetic and phenotypic divergence.

Restoration Phases: Broodstock development phases will focus on collecting genetic samples from hatchery returns to measure the rate of divergence. Genetic analysis during natural production phases will included naturally spawning coho as described above.

Methods: We propose to measure genetic divergence using 35 SNP markers. To do so, we intend to sample tissue from a minimum of 60 adult coho from each of four study groups: 1) adults destined for natural spawning; 2) adults collected for broodstock; 3) naturally produced smolts; and 4) hatchery origin smolts. Over time the data will allow us to estimate three types of genetic drift:

- 1) Changes in allele distribution between parent and progeny life history stages (e.g., drift occurring between the adult spawning population and their progeny) relative to the amount of genetic divergence expected to result from genetic sampling error attributed to reproductive events (Weir 1996). In addition, by measuring changes in composite haplotype¹² frequencies we can quantify variation in reproductive success on a very broad scale. These data will be used to scale the relevance of statistical tests of genetic differentiations (e.g., genetic sampling error will be included as a component of variance when assessing differentiation between hatchery and natural-origin adults and progeny).
- 2) Genetic variation present in the hatchery broodstock compared to the naturally spawning population component. This will allow us to determine whether broodstock collection methods are effectively achieving a representative sample of returning adults. These data will be helpful in optimizing broodstock collection protocols for coho salmon reintroduction efforts.
- 3) Over time, as the broodstock development process progresses, we will be able to determine the length of time necessary to genetically recognize mid-Columbia coho salmon as a distinct spawning population from the lower river source populations.

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¹² Haplotype – The composite genotype of multiple loci that can provide a "fingerprint" for various lineages, populations, or individuals.

7.3.3 Contemporaneous Sperm Cryopreservation

Objective: To determine the biological significance of changes in phenotypic or genetic traits.

Rationale: Neither neutral genetic data nor phenotypic differentiation can be used exclusively as a direct measure of local adaptation. Therefore we propose to directly measure the accumulation of locally useful traits using contemporaneous milt cryopreservation. In 2002 and 2003 we cryo-preserved milt from 50 males. These males represent returns of Lower Columbia River (LCR) brood and first generation Mid-Columbia River (MCR) brood coho. After a period of 5 to 10 coho salmon generations, the cryopreserved milt will be used to directly measure any observed survival benefits of the local adaptation process.

Hypothesis:

 \circ H_o: Survival source stock cross \geq Survival first generation cross \geq Survival second generation cross \geq Survival locally adapted stock

Restoration Phases: Milt cryopreservation during BDP1; experimental crosses during the natural production phases.

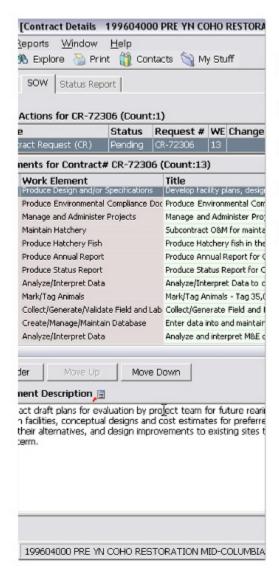
Methods: In 2006 we will also collect milt from second generation returns. After a period of 5 to 10 coho salmon generations (15 to 30 years, depending on the rate of observed phenotypic differentiation), a number of mid-Columbia female coho salmon will be collected and their eggs will be subdivided and fertilized to create the following crosses

- 1) source stock x mid Columbia female;
- 2) first generation x mid-Columbia female;
- 3) second generation x mid-Columbia female; and
- 4) mid-Columbia male x mid-Columbia female.

If natural selection has resulted in a survival advantage (i.e., local adaptation), we would expect cross one to have the lowest survival, cross four to have the highest survival, and crosses two and three to be intermediate.

Power analysis will be used to determine the required number of matings to achieve adequate statistical power. Resulting progeny will be differentially marked to allow identification of returning adults. We would compare a suite of life history characters, which would include run timing, maturation timing, fecundity, egg size, length at age, sex ratio and perhaps body morphometrics and neutral quantitative traits that are highly heritable. We will also evaluate genetic differences between groups using allelic frequencies. A combination of neutral and adaptive SNP loci will be the primary markers.

Chapter 8. Cost Estimates and Schedules



- 8.1 Introduction
- 8.2 Schedules
- 8.3 Capital Costs
- 8.4 Operating Costs
- 8.5 Total Program Cost Schedule

Chapter 8. Cost Estimates and Schedules

8.1 Introduction

This chapter presents project schedules and estimated costs for all the program elements. Timetables for fish releases, facility development, and the monitoring and evaluation plan are based on program objectives described in Chapters 4 and 5.

The capital and operating costs of the proposed coho reintroduction program are for the period 2006 - 2026. The estimating procedures used are detailed in the Appendices. The methods used produce an accuracy higher than $\pm 7.3\%$ to 50%, the level suggested in the 3 Step review process description (NPPC 2001).

Operating cost estimates also have a high degree of accuracy. They are based on the actual costs of operating the feasibility phase of the MCCRP. The cost structure of all the elements of operation are well defined through these current project budgets and are adjusted to predict future costs.

Estimated expense totals are shown in the following tables both with and without cost sharing amounts. Project support currently being provided (detailed in the following sections) is expected to continue in future years and is shown in red typeface in the tables. In addition, there may be other funding contributions that are not listed. For example, land purchase funds for sites that have high value as habitat may be supplemented by resource agencies and groups. When this program receives the authority and funding from NPCC and BPA to continue its operation, the Grant, Chelan and Douglas County PUDs are obligated to support the coho reintroduction program as part of their Hatchery Compensation Plan (HCP) mitigation responsibility, resulting in additional cost-sharing.

8.2 Schedules

While the proposed reintroduction plan maximizes use of existing facilities (trapping, spawning, incubation, rearing, and acclimation), development of the project requires that several evaluation processes be conducted, that designs be completed and that permits be obtained for new facilities. These new facilities include a small adult holding and incubation site in the Wenatchee subbasin, two constructed habitats for rearing in the Methow subbasin, and five acclimation sites that involve varying degrees of construction in both basins (see Chapter 6).

Design, permitting and construction activities are scheduled to meet program requirements. New facilities are not required in the broodstock development phases. Natural production phases start in 2011 in the Wenatchee and 2012 in the Methow. New facilities will need to be operational by these dates.

The general schedule shown in Table 8-1 displays how each of the program facility development elements are structured within the NPCC step review process. Facility construction can begin after the Step 3 review in 2009, allowing facilities to be in use by the required dates.

2006 2007 2009 2010 JFM AMJ JAS OND JFM AMJ JAS OND JFM AMJ JAS OND NPPC STEP REVIEW PLANNING DESIGN PERMITS NEPA FSA Facility CONSTRUCTION Wenatchee Methow Step 2

Table 8-1. Planning, design, permit, and construction schedule

8.2.1 Smolt Release

The smolt release schedule, shown in Table 4-3 (Chapter 4), guides timing of the facility development tasks and the calculation of program capital and operating costs.

8.2.2 Facility Development

Development of the project requires that several evaluation processes be conducted, that designs be completed, and that permits be obtained for new facilities. Table 8-2 shows the planned schedule for each of the facility development elements and the tasks that support the completion of those elements. The tasks are described in more detail in Chapter IV.A.1 of Appendix D.

This is an aggressive schedule that assumes that Step 1 review of the Master Plan will be completed by the end of December 2006; that the NEPA and ESA permit process are completed in 18 months from completion of the Step 1 review; that the Step 2 review process takes 3 months; and that the Step 3 review can be completed in the third quarter of 2009. To meet this timetable, it is expected that fast-track planning and design procedures will be used. For example, facility permitting time periods can be shortened by submitting water rights

applications prior to preliminary designs being completed, and land purchase can be expedited by conducting preliminary discussions with land owners at proposed facility locations prior to a Step 3 decision.

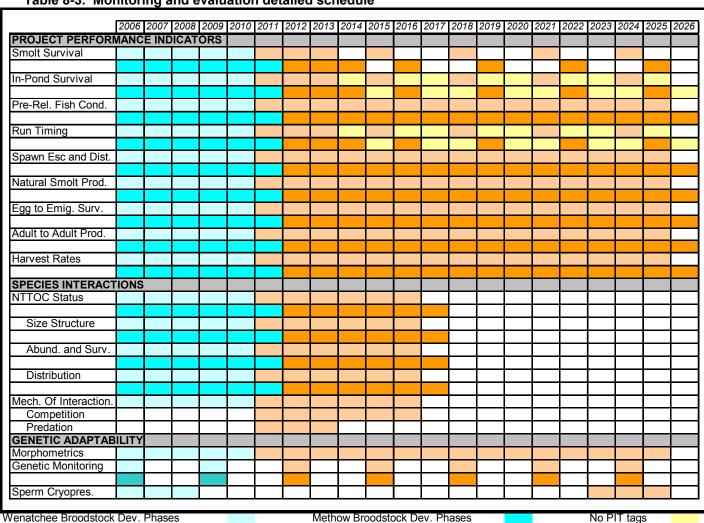
Table 8-2. Detailed schedule for planning, design and construction

ELEMENTS			006				07				80				109)10	
Tasks	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	ONE												
NPPC STEP REVIEW																				
Step 1																				
Step 2																				
Step 3																				
PLANNING																				
Coord. Step Process																				
Site Data Collection																				
FACILITY DESIGN																				
Preliminary																				
Wenatchee																				
Methow																				
Final																				
Wenatchee																				
Methow																				
PERMITS																				
Surveys, Studies																				
Cultural Resources																				
Wetlands, Plants																				
Flood																				
Ground Water																				
Surface Water																				
Listed Species																				
Other Species																				
Discharge Impacts																				1
NEPA																				1
Scoping, SOW																				
Draft EIS																				-
Public/Agency Input																				t
Final EIS, ROD																				
ESA																				1
HGMP, BA																-				
Public/Agency Input																				<u> </u>
																				
Facility Water Rights																				\vdash
JARPA																				1
Critical Areas							-		-	-	-									1
										-	-									_
CONSTRUCTION																				
CONSTRUCTION Deal Fatate Appraisale																				
Real Estate Appraisals										ļ	-				ļ					
Environ. Land Audits									-	-	-				-					<u> </u>
Land Purchase																				1
Wenatchee Con.																				
Methow Con.																				

8.2.3 Monitoring and Evaluation

Table 8-3 shows the planned schedule for the monitoring and evaluation tasks. The tasks are described in detail in Chapter 7.

Table 8-3. Monitoring and evaluation detailed schedule



Wenatchee Broodstock Nat. Prod. Phases

Methow Broodstock Nat. Prod. Phases

8.3 Capital Costs

The total estimated project capital cost is \$9,922,000. Planning, design, and permitting make up \$1,916,000 of this total, land purchases total \$1,789,000, capital equipment totals \$1,280,000 and facility construction makes up the remaining \$4,937,000.

The conceptual design for the natural production phases proposes that lower river hatcheries rear 85% of the program fish and that two new constructed habitats on the Methow would rear the remaining 15%. A spawning and early incubation facility is proposed near Dryden in the Wenatchee basin.

The acclimation system features multiple sites, with emphasis placed on the use of existing ponds that have gravity flow, and surface water supplies. In both Wenatchee and Methow subbasins, 9 release sites form the recommended natural production acclimation system for a project total of 18 sites. Two of these sites are the constructed habitats; of the other 16, 7 exist and have previously been used by the MCCRP.

8.3.1 Planning, Design, and Permits

Table 8-4 summarizes the subcontractor costs for the planning, design, and permitting element of the proposed program by task, by NPCC step, and by year. Table 8-5 details these costs and their timing. Yakama Nation personnel will be major contributors to these efforts; their costs are included under *Operating Costs*, *General and Administrative*.

Table 8-4. Planning, design, and permits cost summary

SUMMARY BY TASK	
PLANNING	\$ 388,000
DESIGN	\$ 652,975
PERMITS	\$ 875,355
SUMMARY BY STEP	
STEP 1	\$ 40,000
STEP 2	\$ 1,325,840
STEP 3	\$ 550,490
SUMMARY BY YEAR	
2006	\$ 40,000
2007	\$ 993,590
2008	\$ 469,872
2009	\$ 412,867
TOTAL	\$ 1,916,330

Table 8-5. Planning, design, and permits costs details

(in Dollars /1,000)

	_															
			06	0.110	.=		07	01/5	.=		80	0.1/0			09	
	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	OND	JFM	AMJ	JAS	ONE
PLANNING																
Coordinate Step Process	10.0	10.0	10.0	10.0								7.0	7.0	7.0	7.0	
Site Data Collection					40.0	40.0	40.0	40.0	40.0	40.0						
FACILITY DESIGN																
Preliminary																
Wenatchee					24.6		24.6	24.6	24.6	24.6						
Methow					11.7	11.7	11.7	11.7	11.7	11.7						
Final																
Wenatchee												73.8				
Methow												35.0	35.0	35.0	35.0	
TOTAL PLAN. & DESIGN	10.0	10.0	10.0	10.0	89.6	89.6	89.6	89.6	89.6	89.6	0.0	115.8	115.8	115.8	115.8	(
PERMITS																
Surveys, Studies																
Cultural Resources						6.0	6.0									
Wetlands, Plants						6.0	6.0									
Flood						10.0	10.0									
Ground Water Withdrawal						10.0	10.0									
Surface Water Withdrawal						12.5	12.5									
Listed Species					3.3	3.3	3.3	3.3	3.3	3.3						
Survey and Manage Species					3.3	3.3	3.3	3.3	3.3	3.3						
Discharge Impacts					3.3	3.3	3.3	3.3	3.3	3.3						
NEPA																
Scoping, SOW					50.0											
Draft EIS						100.3	100.3	100.3								
Final EIS, Record of Decision								110.0	110.0							
ESA																
Edit HGMP, BA					6.7	6.7	6.7									
Public, Agency Review								3.3	3.3	3.3						
Facility																
Water Rights					5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	
JARPA												6.0	6.0	6.0	6.0	
Critical Areas												5.1	5.1	5.1	5.1	
Construction												5.3	5.3	5.3	5.3	
TOTAL PERMITS	0.0	0.0	0.0	0.0	72.1	167.0	167.0	229.1	128.8	18.8	5.5	21.8	21.8	21.8	21.8	
TAL PLAN, DESIGN, PERMITS	10.0	10.0	10.0	10.0	161.7	256.6	256.6	318.7	218.4	108.4	5.5	137.6	137.6	137.6	137.6	(

Key: Step 1 Step 2 Step 3

Following are notes on the *Planning*, *Design*, and *Permits* tasks.

Planning

- Coordinate Step Process these are the costs for subcontractors to support completion of the master plan, preliminary design, NEPA and ESA evaluations, and final design.
- Site Data Collection data (listed in the C. appendices) will be collected during the preliminary design phase. These costs are derived from similar costs for developing the current MCCRP facilities.

Facility design

- Preliminary Preliminary and final design costs are estimated at 15% of construction costs. Of the 15%, preliminary design will be one-third of this amount.
- Final these costs include preparation of engineering designs, value engineering reviews, bid documents, and management of the contractor bid process.

Permits

A full list of fish facility permits is shown in Table 8-6. Every permit listed will not be required for each site due to differing levels of development and local conditions. NEPA and ESA work will be done concurrently. Much of the effort will be interrelated, with listed species impacts forming an important part of NEPA analyses.

Table 8-6. Environmental process and permit requirements

NAME	AGENCY	COMMENTS
SEPA and NEPA	•	•
ENVIRONMENTAL CHECKLIST (SEPA)	Lead Agency	Agency makes Determination of Significance (DS) decision based on
		checklist. DS (forces an EIS), Mitigated DNS, or DNS issued
DRAFT EIS	Lead Agency	Scoping helps determine the content of the EIS
FINAL EIS	Lead Agency	Addresses comments received during 45-day draft EIS comment period
ROD	Lead Agency	Record of Decision
JARPA - Joint Aquatic Resource Permits	Application	
HYDRAULIC PROJECT	WDFW	Use, divert, obstruct, or change natural flow
APPROVAL (HPA)		Screens: 0.4 fps, 1.75mm bar, 2.4mm perf plate, 2.2mm wire mesh
SHORELINES SUBSTANTIAL	Local Govt	In 100-yr. floodplain or within 200 ft. of high water > \$2,500
DEVELOPMENT		
COMPLIANCE WITH CRITICAL	Local Govt	Critical areas are designated by local governments
AREAS STANDARDS		
FLOODPLAIN MANAGEMENT	Local Govt	
401 WATER QUALITY CERT.	WDOE	Applicant for Fed license or permit for filling or exc. in water or wetlands
EXCEEDANCE OF WATER	WDOE	Temporary exceedance (may not be included in new JARPA)
QUALITY STANDARDS		
SECTION 404 PERMIT	US ACE	Locating structures, filling, or excavating in water or wetlands
OTHER STATE PERMITS		
ARCHAEOLOGICAL	Ofc of Arch. &	Fed projects require section 106 review
EXCAVATION	Historic Pres.	
NPDES - GENERAL PERMIT	WDOE	May not be needed for <20,000lbs. fish/yr. or <5,000lbs of feed/mo.
FOR UPLAND HATCHERIES		
PRELIMINARY WATER RIGHT PERMIT	WDOE	Required for drilling and testing
CERT. OF WATER RIGHT	WDOE	Water use permit is the original application
CHANGE OF WATER RIGHT	WDOE	Location or use changes require permit
FISH/EGG TRANSPORT	WDFW	Main tool for WDFW to control movement of fish
OTHER LOCAL PERMITS		
CONSTRUCTION	Local govt	Building permits (including grading), vary by county
CONDITIONAL USE	Local govt	Activities use subject to public hearings
ZONING CODE VARIANCE	Local govt	
ESA RELATED PERMITS		
BIOLOGICAL EVALUATION (BE or BA)	USFWS, NMFS	Consultation used to show minimal impacts; if services agree, a
		concurrence letter is written
BIOLOGICAL OPINION (BO)	USFWS, NMFS	Issued after formal consultation
HATCHERY & GENETICS	NMFS	Replaces the BE for NMFS purposes
MGMT PLAN (HGMP)		
OTHER		
WETLAND AND FLOODPLAIN	BPA	Normally part of the NEPA document; requirement for federally funded
ASSESSMENT		projects
ENVIRONMENTAL LAND AUDIT	BPA	
· · · · · · · · · · · · · · · · · · ·		

Many of the permit and study costs are derived from similar projects completed by the MCCRP and Yakama Nation in the recent past. These include: ground water withdrawal impact studies, well construction and water rights applications for the MCCRP Rohlfing and Two Rivers sites; flood studies, groundwater studies, and facilities permit applications for the YKFP (Yakama Klickitat Fisheries Project) Wahkiacus Hatchery and Acclimation Facility; acclimation discharge impact study done on the MCCRP Rohlfing, Butcher, and Beaver sites; cultural resources, plant, and wetland evaluations done for several potential acclimation sites in the Wenatchee watershed;

and floodplain and wetland assessments, Joint Aquatic Resources Permit Application (JARPA) and environmental checklist applications submitted for several MCCRP acclimation sites including Two Rivers and Rohlfing.

Environmental review cost estimates were provided by Nancy Weintraub (BPA, Team Lead for Fish and Wildlife Environmental Review). The BPA estimate of \$750,000 includes NEPA and ESA reviews, and the surveys and studies listed in Table 8-6.

Permit task descriptions:

Surveys, Studies

- o Cultural Resources 3 separate surveys of multiple sites are assumed.
- o Wetlands, Plants 3 separate surveys of multiple sites are assumed.
- o Flood 3 separate surveys of multiple sites are assumed.
- o Ground Water Withdrawal 4 of the sites require ground water withdrawal studies. These include the digging of test pits, as well as evaluating potential yields and impacts on both the environment and other users of the planned withdrawal. Well construction is included under *Capital Costs*.
- Surface Water Withdrawal 5 sites plan on new surface water withdrawals.
 These impacts on stream flow will need to be studied.
- Listed Species to determine the presence of ESA-listed species at or near the facilities and the potential impacts from construction and operation.
- Other Species work on non-listed species will be done in conjunction with listed species.
- Discharge Impacts the effect of feeding coho in existing natural ponds will be investigated.

NEPA

- Scoping, SOW this first step in the NEPA process includes preparing a Notice of Intent and a Statement of Work, meeting with cooperating agencies, and holding scoping meetings.
- o Draft Environmental Impact Statement (EIS) prior to drafting the EIS, scoping comments will be reviewed, issues identified, and public and agency input evaluated. Results from surveys and studies will be included in the draft EIS.
- Final EIS, Record of Decision comments received from public review of the draft EIS are evaluated during production of the final EIS.

ESA

- O Prepare a Hatchery and Genetics Management Plan (HGMP) and Biological Assessments (BAs) the MCCRP HGMP will need to be rewritten to reflect program changes; assessments of the impacts of the proposed master plan facilities and activities impacting listed species will need to be prepared.
- Public and Agency Review

Facility

- Water Rights results from the completion of the ground water and surface water withdrawal studies will be used to support the water rights applications.
- o JARPA the Joint Aquatic Resources Permit Application includes several separate permits (see Attachment 2).
- Critical Areas the proposed facilities are near water, requiring shorelines and critical areas permits.
- o Construction local grading and building approvals are required.

As a check of these estimates, a comparison of permit costs with other projects can be made. The permit total for the MCCRP is estimated to be \$875,000 (see Table 8-4). Costs for other projects are:

- NE Oregon Hatchery Project: Approximately \$1,000,000 (personal communication Mickey Carter, Supervisory Environmental Protection Specialist, BPA)
- Average EIS costs of a wide range of Department of Energy (DOE) projects completed in 2005 (USDOE 2005): \$1,434,000.

The MCCRP permit costs are expected to be lower than these values because significant amounts of environmental evaluation have been completed during the feasibility phase of this project. Impacts on listed fish have been studied for several years by the MCCRP monitoring and evaluation program in coordination with the project's TWG, members of which helped guide study designs and reviewed results. Also, work done during master plan development will be applied to permitting, further reducing costs.

8.3.2 Facilities and Capital Equipment

This cost element includes land purchase, facility construction, and capital equipment used in the operation of the sites. Two estimating methods were used. One is based on the average values of similar projects and is detailed in Appendices B.1 and B.2. The other is based on site-specific facility designs and is shown in Appendices C.1, C.2, C.3, and C.4. The averaging method uses actual facility costs, reducing variations that result from site properties that are not known until preliminary design studies are completed (such as ground water depths, soil conditions, etc.). The site-specific cost estimates take into account unique features of sites that are known, such as access road lengths, piping distances, etc. The site-specific costs were used in the capital cost estimates in Table 8-7; the average values in the B appendices provide a comparison.

Land purchases totaling \$1,789,500 are included in these capital costs. Purchases are planned at five sites: Dryden, Tall Timber, Chikamin, Goat Wall, and Heath Ranch. Because most of these sites are in areas that have important habitat for coho and other species, other agencies such as WDFW may be willing to share costs of land purchases. All other sites (acclimation) are either on private land that will be leased or on federal/state land where land use agreements will be obtained

Construction and land

Existing hatcheries that have no associated capital cost will provide the bulk of pre-smolt production. Several of the proposed new facilities have multiple functions: the adult holding, spawning, and incubation facility near Dryden in the Wenatchee basin (see Section 6.2.3 and Appendix C.1 for design and cost details) and two constructed habitats proposed as rearing/acclimation sites in the Methow (see Section 6.2.4 and Appendix C.2).

These multi function sites have the following design features:

- o Dryden an incubation building, spawning shed, and 3 concrete adult holding raceways supplied by water from a constructed infiltration gallery.
- Eightmile a constructed habitat supplied with a surface water intake on Eightmile Creek and ground water from existing and new wells.
- Heath an existing habitat with a new outlet structure for controlling and monitoring fish passage.

Like other aspects of the proposed program, acclimation also relies on existing sites with little capital cost. The five new facilities (see Section 6.3 and Appendices C.3 and C.4 for design and cost details) have low costs relative to other acclimation sites in the region due to their use of constructed or existing natural ponds and water supplies where available.

The acclimation sites that require major construction have the following design features:

- o Tall Timber this is planned to be a fully constructed acclimation site, with two ponds supplied by pumped surface and ground water.
- Chiwawa second-use or excess water from the existing acclimation site will operate two new coho acclimation ponds.
- Chikamin a new large pond and a gravity flow water intake will be constructed.
- o Lincoln existing ponds will be supplied by new wells.
- Goat Wall a small well and an existing spring will supply a new acclimation pond.

Table 8-7. Facility construction cost

	2009	2010	2011	2012
MULTI-FUNCTION				
Dryden		\$ 1,897,072		
Eightmile			\$ 1,024,571	
Heath			\$ 551,651	
ACCLIMATION				
Tall Timber		\$ 1,144,508		
Chikamin		\$ 733,047		
Chiwawa		\$ 459,603		
Misc Wenatchee		\$ 93,600		
Lincoln			\$ 254,183	
Goat Wall			\$ 536,817	
Misc Methow			\$ 30,680	
TOTAL		\$ 4,327,831	\$ 2,397,902	

Capital equipment

Capital equipment is assumed to have a 10-year average life. Replacements at this interval are included in the cost schedule in Table 8-8.

Table 8-8. Capital equipment cost schedule

(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EQUIPMEN	NΤ																				
M&E Equipment		0.02		\Box	\Box	\Box						0.02									
O&M Equipment		0.01	0.02									0.01	0.02								
Multi-Function Fac.					0.20	0.13									0.20	0.13					
Acclimation Fac.					0.13	0.12									0.13	0.12					
TOTAL	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00

Capital Equipment costs include the following:

- M&E Equipment the main capital purchases for the Monitoring and Evaluation program are two rotary smolt traps and electrofishing gear.
- O&M Equipment fish transport tanks and CWT detection systems are needed for broodstock collection.
- Multi-Function Facility Equipment major equipment to be used at the adult holding and incubation facility and the constructed habitats includes chillers, pumps, generators, and trailers
- Acclimation Facility Equipment capital equipment needed at the acclimation sites includes pumps, generators, and trailers.

8.4 Operating Costs

8.4.1 Operation and Maintenance

Rearing

The rearing costs estimated in Table 8-9 are for production of fish to pre-smolt size while in hatcheries. Transportation of these smolts is included, as is adult holding, spawning, and incubation of Methow brood under contract with the U.S. Fish and Wildlife Service (USWFS). Wenatchee brood and egg handling will be done by Yakama Nation personnel when the Dryden facility is completed and is included in the next section (Other O&M).

Hatchery rearing cost estimating procedures are detailed in Appendix B.1. They are based on the average operating costs of five existing Columbia River hatcheries. A formula was developed using these data that allows predictions to be made for the cost of producing various numbers of fish.

$$340,000*[.4+0.6*[(number of fish produced)/1,000,000]]$$

Reference comparisons on the accuracy of this formula reveal that it matches the current operating costs for full hatcheries, and it also compares closely with the amounts currently being paid by the MCCRP.

This same formula is applied to existing hatcheries, with the exception of Willard, and to the constructed habitats. The Willard costs are independent of the number of fish produced because

the entire hatchery is dedicated to MCCRP coho production. The habitats have lower culturing costs than hatcheries due to natural management approaches; however, predator control methods that have been effective at existing acclimation sites include non-lethal hazing by personnel, which will increase overall operating costs to levels that are similar to conventional hatcheries.

The last cost element in Table 8-9 is cost sharing. This is the amount of contribution being made by fishery agencies to the MCCRP for hatchery operations. NOAA, through the Mitchell Act, supports operation of Willard (\$128,000 per year) and Cascade (\$277,000 per year) hatcheries. The USFWS also contributes a portion (assumed to be 10% of the total, or \$31,400 per year) of the maintenance fees for operating the Leavenworth, Entiat, and Winthrop hatcheries.

Table 8-9. Rearing cost detail

(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
HATCHERIES																					
Cascade	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.27	0.22	0.22	0.22	0.22	0.22	0.13
Willard	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32							
Winthrop	0.19																				0.19
Hauling	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Adult Hold., Spawr	0.29	0.29	0.29	0.29	0.29	0.31	0.40	0.40	0.34	0.29	0.29	0.29	0.29	0.29	0.22	0.16	0.16	0.16	0.16	0.16	0.09
CONSTRUCTED HA	BITAT	S																			
Eightmile																					0.15
Heath Ranch							0.16	0.16	0.16	0.15	0.15	0.15	0.15	0.15	0.15	0.14	0.14	0.14	0.14	0.14	0.14
SUBTOTAL	1.10	1.09	1.09	1.09	1.09	1.12	1.55	1.55	1.48	1.41	1.41	1.41	1.41	1.41	1.00	0.87	0.87	0.87	0.87	0.87	0.71
COST SHARING																					
Rearing	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.38	0.38	0.38	0.38	0.38	0.29
TOTAL	0.66	0.66	0.66	0.66	0.66	0.68	1.11	1.11	1.05	0.97	0.97	0.97	0.97	0.97	0.58	0.49	0.49	0.49	0.49	0.49	0.42

Other O&M

This cost element (Table 8-10) covers all the facility operating and maintenance costs except rearing. These include the expenses of operating acclimation, brood collection, spawning, and incubation facilities. Estimates are based on recent MCCRP expenses. The 2006 budget was used as the basis for predicting the costs of future program phases. Adjustments were made to reflect changes in the number of facilities operated and numbers of fish handled. This total does not include: rearing, planning or design costs, monitoring and evaluation, or general and administrative costs.

During the Broodstock Development Phases (BDP1 and 2), Methow costs will be lower than in the Wenatchee. During BDP1, four acclimation sites will operate in the Wenatchee and one in the Methow. During BDP2, six are planned for the Wenatchee and three in the Methow. During the natural production phases, coho will be released from 9 sites in both the Wenatchee and Methow basins. As release numbers are reduced in future natural production phase years, the number of acclimation sites used will also be reduced.

Table 8-10. Operation and maintenance cost detail

(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Acclimation																					
Personnel	0.17	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
Operating Supplies	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Vehicles	0.02	0.03	0.03	0.03	0.03	0.04	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.03
Land Agreements	0.01	0.01	0.01	0.01	0.02	0.02	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.02
Broodstock Collecti	on																				
Personnel	0.16	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Vehicles	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.04	0.04	0.04	0.05	0.03	0.03	0.03	0.03	0.03	0.02
Spawning																					
Personnel	0.03	0.03	0.03	0.03	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.01
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Vehicles	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Incubation																					
Personnel	0.05	0.06	0.06	0.06	0.07	0.08	0.08	0.08	0.08	0.07	0.07	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.05	0.0
Operating Supplies	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
Vehicles	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0
TOTAL	0.52	0.59	0.59	0.59	0.64	0.67	0.74	0.74	0.74	0.73	0.72	0.66	0.66	0.66	0.69	0.63	0.63	0.63	0.63	0.63	0.4

8.4.2 Monitoring and Evaluation

Estimates of the program costs for the monitoring and evaluation program element are based on current MCCRP expenses. The 2006 monitoring and evaluation budget, with tagging excluded, is \$290,000. This budget was divided by task, and the cost for each was extended to future years. Estimates were made for tasks that will not begin until after 2006. Coded wire tagging costs were changed proportionate to the numbers of fish released per year. PIT tags are expected to remain approximately the same, independent of total release numbers.

Monitoring & Evaluation (M&E) costs are shared with WDFW, the HCP hatchery compensation M&E plan, and BPA project number 2003-017-00. Smolt traps at Monitor, Chiwawa, White, Upper Wenatchee, Methow, and Twisp, currently funded through alternate sources, are an integral part of the proposed M&E plan; they would provide data to monitor natural coho production and NTTOC status. The total on the last line of Table 8-11 shows the estimated yearly sum for M&E with these cost-share amounts provided by other agencies removed (shown in red).

Table 8-11. Monitoring and evaluation cost detail

(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	202
PROJECT PERFORM	ANCE I	NDICA	TORS																		
Smolt Survival	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	-	0.04	-	-	0.04	-	-	0.04	-	-	0.04	-	-
In-Pond Survival	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Pre-Rel. Fish Cond.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Run Timing	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.01	0.02	0.01	0.00
Spawn Esc and Dist.	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0
Natural Smolt Prod.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.0
Egg to Emig. Surv.	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.0
Adult to Adult Prod.	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.0
Harvest Rates	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.0
SPECIES INTERACTI	ONS																				
NTTOC Status																					
Size Structure	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Abund. and Surv.	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Distribution	-	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	-	-	-	-	-	-	-	-	-	-
Mech. Of Interaction.																					
Competition	-	-	-	-	-	0.02	0.02	0.02	0.02	0.02	0.02	-	-	-	-	-	-	-	-	-	-
Predation	-	-	-	-	-	0.03	0.03	0.03	0.03	0.03	0.03	-	-	-	-	-	-	-	-	-	-
GENETIC ADAPTABII	İTY																				
Morphometrics	-	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.0
Genetic Monitoring	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-	0.06	-	-
Sperm Cryopres.	-	0.02	0.02	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	0.02	0.02	-
SMOLT TRAPS																					
Operation and Maint.	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.7
SUBTOTAL	1.01	1.17	1.17	1.21	1.15	1.19	1.26	1.19	1.13	1.26	1.13	0.94	1.06	0.94	0.94	1.06	0.94	0.95	1.07	0.95	0.8
COST SHARING																					
Smolt Trap	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.7
TOTAL	0.24	0.39	0.39	0.44	0.38	0.42	0.48	0.42	0.36	0.48	0.36	0.16	0.28	0.16	0.16	0.28	0.16	0.18	0.30	0.18	0.0

8.4.3 General and Administrative

The general and administrative cost element (Table 8-12) covers expenses that are spread over all project functions. These include: program administration; support for planning and design; indirect services; and running project offices. Numbers are based on current MCCRP expenses.

Table 8-12. General and administrative cost detail

(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
G&A																					
Administration	0.09	0.09	0.09	0.09	0.10	0.10	0.11	0.11	0.11	0.11	0.11	0.10	0.10	0.10	0.11	0.10	0.10	0.10	0.10	0.10	0.07
Office, Facility Maint.	0.06	0.06	0.06	0.06	0.06	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.06	0.06	0.06	0.06	0.06	0.05
Indirect	0.20	0.20	0.20	0.20	0.21	0.22	0.24	0.24	0.24	0.24	0.24	0.22	0.22	0.22	0.23	0.21	0.21	0.21	0.21	0.21	0.16
TOTAL	0.34	0.34	0.34	0.34	0.37	0.39	0.43	0.43	0.43	0.42	0.42	0.39	0.39	0.39	0.40	0.37	0.37	0.37	0.37	0.37	0.27

8.5 Total Program Cost Schedule

The yearly cost for all project elements is shown in Table 8-13, for the 20-year project lifetime. The values on the last line show the estimated total yearly project sum, with cost-share amounts provided by other agencies removed (shown in red).

Table 8-13. MCCRP total project cost schedule

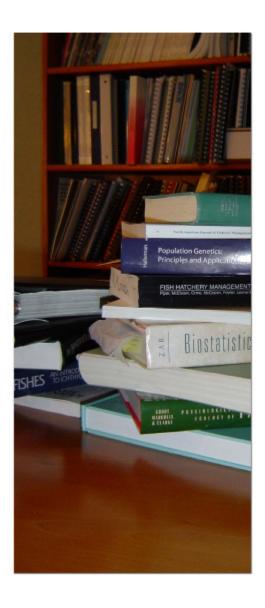
(in Dollars /1,000,000)

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL																					
Plan, Design, Per.	0.04	0.99	0.47	0.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Construction	0.00	0.00	0.00	0.00	4.33	2.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Capital Equipment	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00
TOTAL CAPITAL	0.04	1.03	0.49	0.41	4.66	2.65	0.00	0.00	0.00	0.00	0.00	0.04	0.02	0.00	0.33	0.25	0.00	0.00	0.00	0.00	0.00
OPERATING																					
Rearing	1.10	1.09	1.09	1.09	1.09	1.12	1.55	1.55	1.48	1.41	1.41	1.41	1.41	1.41	1.00	0.87	0.87	0.87	0.87	0.87	0.71
Other O&M	0.52	0.59	0.59	0.59	0.64	0.67	0.74	0.74	0.74	0.73	0.72	0.66	0.66	0.66	0.69	0.63	0.63	0.63	0.63	0.63	0.47
M&E	1.01	1.17	1.17	1.21	1.15	1.19	1.26	1.19	1.13	1.26	1.13	0.94	1.06	0.94	0.94	1.06	0.94	0.95	1.07	0.95	0.86
Tagging	0.48	0.48	0.48	0.48	0.48	0.52	0.65	0.65	0.48	0.48	0.40	0.40	0.48	0.40	0.29	0.28	0.20	0.20	0.28	0.20	0.09
G&A	0.34	0.34	0.34	0.34	0.37	0.39	0.43	0.43	0.43	0.42	0.42	0.39	0.39	0.39	0.40	0.37	0.37	0.37	0.37	0.37	0.27
TOTAL OP.	3.46	3.67	3.67	3.71	3.74	3.89	4.62	4.56	4.26	4.29	4.09	3.80	4.00	3.80	3.33	3.21	3.01	3.02	3.22	3.02	2.40
TOTAL COST	3.50	4.70	4.16	4.13	8.4	6.5	4.62	4.56	4.26	4.29	4.09	3.83	4.02	3.80	3.67	3.46	3.01	3.02	3.22	3.02	2.40
Rear. Cost Share	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.42	0.38	0.38	0.38	0.38	0.38	0.29
M&E Cost Share	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77	0.77
TOTAL COST	2.29	3.49	2.95	2.92	7.19	5.33	3.41	3.35	3.05	3.08	2.88	2.62	2.81	2.58	2.47	2.31	1.86	1.87	2.07	1.87	1.33

Notes:

- Abbreviations used in the table: O&M Operation and Maintenance; G&A General and Administrative; M&E Monitoring and Evaluation.
- Capital construction costs are assumed to be incurred one year before site operation begins.
- Cost sharing support for the project is removed from the total to produce the values in the last row
- M&E cost-share represents only current cost share opportunities and does not include HCP coho mitigation.
- Capital costs do not include depreciation. All amounts are in 2005 dollars and are not inflated.

Chapter 9. References



Chapter 9. References

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The following appendices are provided as separate documents to this Master Plan.

Appendix A Fish Culture Guidelines

Appendix B.1 Rearing Facilities Alternatives

Appendix B.2 Acclimation Facilities Alternatives

Appendix C.1 Wenatchee Rearing Facilities

Appendix C.2 Methow Rearing Facilities

Appendix C.3 Wenatchee Acclimation Facilities

Appendix C.4 Methow Acclimation Facilities

Appendix D Schedules and Costs

Appendix E Capacity and Release Estimates

Appendix F AHA Calculations

Appendix G Hatchery and Genetics Management Plan

Appendix H Annual Reports